SCIENTIFIC AMERICAN

No. SUPPLEMENT 234

Scientific American Supplement, Vol. IX., No. 234.
Scientific American, established 1845.

NEW YORK, JUNE 26, 1880.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

MM. PELOUZE AND AUDOUIN'S GAS PURIFIER.

THE accompanying engravings represent a very curious and successful apparatus for purifying coal gas by mechanical condensation. When gas issues from the condensers of gas works it still contains much tarry matter, no matter how carefully the washing and cooling processes have been carried out. That this tar does not reach service pipes and clog mains is due entirely to the fact that it is caught in the lime purifiers, which it quickly renders foul. The apparatus which we illustrate receives all the tar before it reaches the purifier. The following description with the drawings will make the action of the apparatus quite intelligible. The principle involved is that of an arrangement which has been used to prevent priming water from reaching a cylinder. The steam flowing through the steam pipe on its way to the engine is made to strike against a flat plate, and the water is thus "knocked" out of it, and flowing down the plate is returned by a drain pipe to the boiler. In the Pelouze and Audouin purifier the gas is made to pass through a great number of holes $\frac{1}{4}$ in. in diameter, and impinge on a solid plate behind. Fig. 3 shows a portion of this part of the apparatus.

Fig. 1 represents in section the condenser connected with the gas main on the works. It consists of a cylinder of perforated sheet iron, constituting the condenser; a channel or annular space in which the cylinder moves and the tar produced by condensation accumulates; a receptacle for the tar overflowing; the gas charged with tar enters at the bottom, and after purification escapes at the top. Above is seen a guide with hydraulic seal and counterbalance weight, allowing of the variation in the movements of the cylinder—which is also a self-acting regulator—proportionately to the quantity of gas produced at any time during the day. Fig. 2 is a plan of the apparatus, and Fig. 3 shows, full size, portions of the plate of perforated sheet iron forming the sides of the cylinder. Before arriving at the purifiers the gas passes through the vertical sides of the sheet iron condensation cylinder, which is of relatively small size; a single one of about 35 cubic feet capacity suffices for gas-works producing 3¼ million cubic feet of gas per twenty-four hours; and the apparatus acts equally well whether the works are provided with exhausters or not. The openings in the cylinder should be proportionate in number to the volume of gas required to pass through the apparatus in a given time. In order to obtain as complete a condensation as possible, the inventors have added to the first set of plates, with which the gas first comes in contact, a second set, which are placed close to the others, so that the stream of gas may sustain two successive collisions against the screens, the effect of which is to produce absolute condensation. As the plain portions only of this second set of plates are brought into action, the inventors have considerably enlarged the diameters of the openings, in order to facilitate the flow of the condensed tarry matters. This arrangement, which has been recently adopted, is found to be very successful. It was of importance to render the apparatus self-acting; that is to say, to so arrange it as to insure the passage of a greater quantity of gas whenever the production of the works increased. The cylinder, properly balanced, is capable of acting as its own regulator. For this purpose it moves in a hydraulic seal, which allows of the closing of those gas passages which are not required to be in action. When the pressure increases—and this will correspond to an increase in the production of gas—the cylinder rises, and a large number of openings is uncovered to allow the gas to pass through. At the expiration of a certain time, variable according to the nature of the tar produced—once or twice a year, at least, or, at most, once a month—the apparatus should be cleaned. This may be effected in a few minutes by immersing the cylinder in a bath of boiling water, which liquefies any tar that may be obstructing the orifices.

In an experiment made at the Ternes Station of the Paris Gas Company, which is provided with powerful refrigerators, and produces about 3¼ million cubic feet per twenty-four hours, 556 lb. of tar, and 6½ gallons of very rich ammoniacal liquor were obtained at a relatively low temperature. These quantities represent a period of production of about one million cubic feet of gas. The quantity of tar contained per 35,000 cubic feet was, therefore, about 19¼ lb. From 20 lb. to 22 lb. of tar condensed by the effects of collision may be expected per 35,000 cubic feet of gas when the temperature is relatively low, and when the works are already provided with tolerably powerful cooling apparatus.

Up to the present time the Paris Gas Company has had eight of these condensers erected at its stations at St. Mandé, Les Ternes, Ivry, St. Denis, and at the experimental works at La Villette, and it will successively introduce them into its other stations. Twelve provincial works are now in possession of this condenser, and the managers of these works express themselves satisfied with its working. It has also been adopted in Germany, Switzerland, Belgium, Holland, Italy, and the United States, and quite recently several have been exported to Calcutta and Batavia. In this country it is being introduced by Mr. G. Bower, C. E., St. Neots.—*The Engineer.*

Fig. 1.

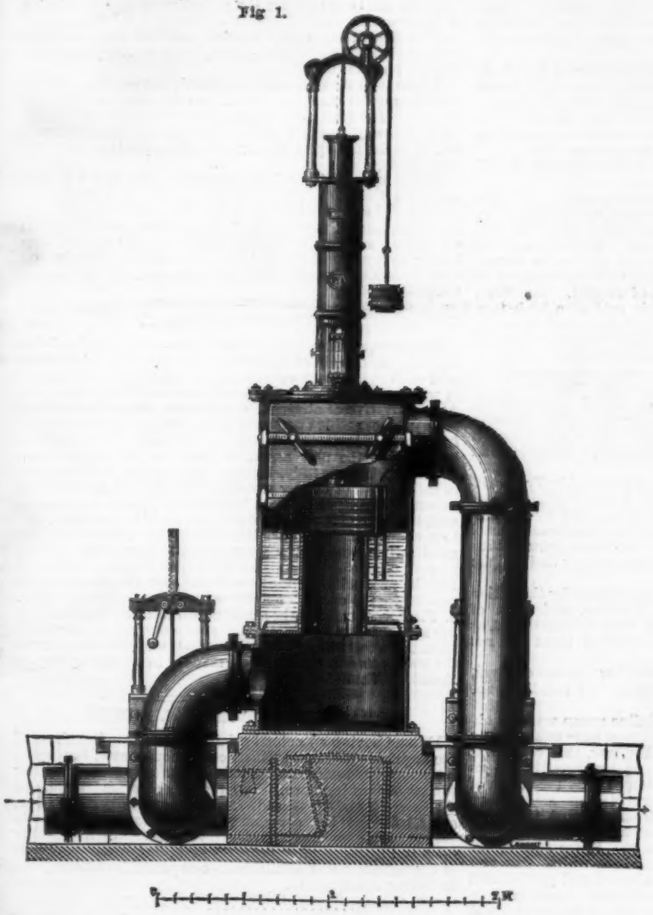


Fig. 2

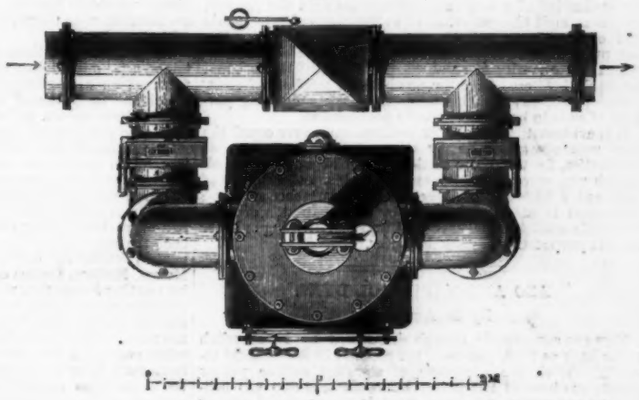
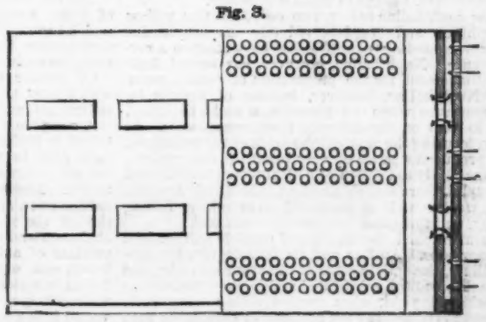


Fig. 3.



ACETATE OF SODA MANUFACTURE.

THE manufacture of pure acetic acid and acetate of soda from pyroligneous acid has received much attention at the hands of E. Dollfus, of Mulhouse, and the German periodicals have recently contained notices of his method of proceeding.

The crude distillate obtained by heating wood in closed vessels is redistilled, and this second product is saturated with carbonate of soda, added in small quantities at a time until it no longer reacts acid. After standing for four and twenty hours the liquid is run off from the impurities which have deposited, and the clear solution boiled down and allowed to crystallize.

The crude crystals of acetate of soda thus obtained must then be purified by being dissolved again, and the liquid caused to crystallize. These second crystals are still contaminated with organic matter, and, in order to remove the last traces of this, they are heated carefully until the water of crystallization is driven off; the mass is then removed to another vessel, and strongly heated until it fuses to a thin and homogeneous liquid. The organic matter is thus charred, while the acetate of soda does not undergo any decomposition.

The fused mass is now dissolved in hot water; the liquid is filtered, boiled down, and allowed to crystallize. The crystals are dried at 30° C. in a drying room, or by means of a centrifugal machine specially adapted for that purpose.

The above is by no means the only, nor, perhaps, the best method of manufacturing the pure product. It has been recommended to get rid of the organic matter by means of animal charcoal; this method of purifying the coarse acetate of soda first produced consists in dissolving the crude crystals in water, filtering through animal charcoal, concentrating the liquid by boiling, and finally allowing it to crystallize.

If the crude pyroligneous acid be saturated with lime instead of carbonate of soda, the liquid is decanted as before from the impurities which settle down, and to it is added a certain quantity of sulphate of soda which has been calcined; the filtered liquid then holds acetate of soda in solution, and

the pure salt may be obtained by simple repeated crystallization. But this method entails the necessity of washing repeatedly the sulphate of lime produced and retained on the filters, and so occasions the consumption of large quantities of fuel in order to get rid of all this washing water, for the volume of liquid to be evaporated is very considerable. This is the old process, and, as will be seen, less advantageous than the one first described.

The production of acetic acid from this acetate of soda, by whatever method produced, has become of late years, especially since the vast strides taken by photography, one of the most important branches of chemical manufacture. In order to obtain acetic acid of 7° to 8° Baumé, which corresponds to 1·05 and 1·06 sp. gr., and contains from 40 to 50 per cent. of *glacial* acetic acid, *one* equivalent of the pure crystallized acetate of soda is decomposed by means of *two* equivalents of monohydrated sulphuric acid; the acid so obtained is digested with peroxide of manganese, or with red lead, and then rectified. By collecting the distillate in separate portions, acids of various degrees of strength can be procured.

In order to obtain the glacial acid, Dollfus is inclined to adopt the method of Dr. Melsens, professor of chemistry in Brussels, which consists in preparing anhydrous acetate of *potash*, by saturating *pure* acetic acid with *commercial* carbonate of potash (pearl-ash), evaporating to dryness, and fusing the residue at a heat of 300° C. This anhydrous acetate of potash is mixed with a quantity of pure acetic acid of 7° to 8° Baumé, sufficient to form the acid salt, which is then heated in a suitable vessel.

In this operation a dilute acid first comes over, but as the temperature increases the acid salt is decomposed, and a distillate is obtained *which solidifies on cooling*. The residue is again treated with acetic acid, as before, and a further quantity of acid salt is thus obtained. By rectifying the distillate over freshly-fused acetate of potash, pure glacial acetic acid is obtained.

Another branch of this important manufacture consists in the production of a weak acid to compete with the product known as malt vinegar—that is, to obtain a dilute acetic acid of pure taste, suitable for use as a condiment. For this purpose pure acetate of soda is decomposed with the equivalent quantity of sulphuric acid of 60° Baumé, and the liquid is filtered from the precipitated sulphate of soda, concentrated, and cooled, which causes the remaining portions of soda to be almost entirely precipitated.

It is evident that the latter product can never equal the pure *malt vinegar* made by the well-known process of *acetification*, for the dilute acetic acid produced as above, although very agreeable to the taste, contains both sulphate of soda and a little sulphuric acid, and the presence of these substances is at once detected by the production of colic when this artificial vinegar is used for salad dressing or other dietetic purposes.—*Monthly Magazine.*

AZO AND NAPHTHOL DYES.

By G. AUERBACH.

THE azo compounds, though discovered by Mitscherlich as far back as 1834, possessed till recently little technical interest. With the exception of so-called aniline yellow (amido azo benzol) and phenylen brown (triamido azo benzol), no azo compounds were used in the tinctorial arts, or if they had been introduced into trade their nature was not known. Within the last three years the azo-coloring matters have been more closely examined, and thanks to the existence of so many aromatic amides, which all without exception yield diazo compounds, and to the property of the latter to combine with amides, phenoles, etc., forming substituted azo compounds, we have become acquainted with an assortment of dyes of different colors more numerous even than those obtained from the rosaniline group. Most of the azo dyes run from yellow to orange, but reds, violets, and blues occur also, though in smaller numbers.

Among the naphthaline colors, two only, Martius yellow (dinitro naphthol) and Magdala red (the naphthylamine compound corresponding to saffranine) have reached a certain importance. Naphthaline, however, has served indirectly as phthalic acid for the preparation of eosine, cœruleine, etc. Naphthaline, however, became of greater industrial importance when its phenoles, *a* and *b* naphthol, were made to react on the different diazo compounds. In this manner, by using the monosulpho acids of the naphthols, there were produced a series of very beautiful orange dyes, the tropeolines. By the action of *b* disulphonaphtholic acid upon diazoxylol, there was obtained an exceedingly fine red, which dyes wool as well as cochineal, so as to bear fulling and washing, and threatens to supersede cochineal.

As above mentioned the number of possible aniline dyes is simply enormous. Aniline and its homologues, the substituted anilines, the amidic acids of the aromatic series, the amido-phenoles, and the substituted amido-phenoles (such as picramic acid) all yield, when treated with nitrous acid, diazo compounds possessing the property of combining with mono, di, and tri-amines, and with uni or poly-valent phenoles, and forming mono, di, or triamidoazo compounds, or mono, di, tri, etc., hydroxyazo compounds. According as these azo compounds contain the amido group or hydroxyl groups they are soluble in acids or in alkalies, but it is possible to obtain dyes which contain both the basic and the acid group, and which consequently are soluble both in acids and alkalies. Such a dye is formed by azotizing sulphonaphthylaminic acid, and treating the resultant sulphodiazonaphthalinic acid with aniline.

In practice this class of dyes are of little importance, as the color changes according as the acid or the basic group is neutralized. Altogether, of the numerous azo dyes which have been obtained, and in most cases patented, few have become of commercial importance; a few fine oranges, and the red introduced by the firm Meister, Lucius & Bruning, of Höchst, are probably the only practically valuable representatives of this class of coloring matters, to which may be joined the saffranines, the indulines, and perhaps also methylen blue.

The oldest known azo dye is, as already mentioned, aniline yellow (amido azo benzol). It is formed when a salt of aniline, *e. g.*, the muriate, is mixed with the nitrite of potash—two molecules of the former to one of the latter—and the yellow flocks of diazo amido benzol, which are separated out, are left for a length of time in contact with an aqueous solution of muriate of aniline. The diazo amido benzol, which is first formed, is converted into the isomeric compound, amido azo benzol. This aniline yellow has not met with very extensive application, since other coloring matters yield finer and brighter shades, and are in addition cheaper.

Phenylen brown (triamido azo benzol) is formed from metaphenylen diamine, a compound obtained by reducing metadinitro benzol (melting point 187° Fahr.) with zinc and muriatic acid. If the phenylen diamine thus obtained is treated with nitrite of potash (two molecules of the former to one of the latter) there is formed triamido azo benzol.

Great hopes were at one time entertained concerning the newly obtained diamido azo benzol, but they have not been fulfilled. This compound, which was introduced into the market under the name of chrysoidine, by the firm Williams, Thomas & Dower, of Brentford, is formed when diazo benzol is brought in contact with methylen diamine. Diamido azo benzol is immediately separated, and is obtained in brown pyramidal crystals resembling magenta. If used alone it dyes yellows to yellowish browns, but has generally been used along with magenta for the production of scarlets.

The mixed azo compounds have attained greater importance than all the amido azo benzoles already mentioned, since they combine, with great purity of color, in most cases fastness. The first of the dyes belonging to this class of mixed azo compounds were the tropeolines or oranges. They are obtained by mixing a watery solution of a salt of diazo benzol with *a* or *b* naphthol. In order to make the coloring matter more readily soluble it was converted into the corresponding sulpho acid, or as is preferable, diazo benzol chloride was mixed with *b* sulphonaphtholic acid, obtaining thus at once the sulpho acid of the new compound.

Aniline dissolved in muriatic acid is mixed with the calculated proportion of nitrate of soda, care being taken to prevent a rise of temperature, and the yellow solution of diazo benzol, which is formed, is allowed to flow slowly into a solution of *b* sulphonaphtholic acid, which is constantly kept alkaline. The orange-red solution thus formed is decomposed by the addition of an acid, the precipitate collected, purified by solution in an alkali and reprecipitation with an acid, and dried. In place of aniline, its homologues, the toluidines, xylidines, etc., may be used, and as the molecular weight increases the color seems to turn from yellow towards orange. The substituted anilines, metanitro aniline, etc., yield dyes which have been patented by a firm in Paris. If the sulpho acids of aniline and of its homologues are employed we obtain likewise fine dyes soluble in water, which are isomeric with those prepared from sulphonaphtholic acid with diazo benzol.

Interesting as all these colors are they have not yet obtained a prominent importance. They are certainly manufactured on a considerable scale; but as orange is a color which can be produced in many ways, both beautiful and cheap, these colors, which are rather expensive, have not been able to fulfill the hopes which were entertained.

The prospect was, however, very much modified when it was found possible to prepare a pure red dye, capable of bearing the stocks, by means of the diazo compounds. The only red dye hitherto available for wool was cochineal (?), which was rather dear, and the shades dyed with it had the bad property of being affected by soda. Hence it has long been the wish of dyers to find a cheaper and more permanent substitute for cochineal, and this wish was realized by Messrs. Meister, Lucius & Bruning, of Hochst. This firm, by treating *b* naphthol with sulphuric acid at a high temperature, succeeded in preparing *b* disulphonaphtholic acids, and at the same time it was observed that the crude result of the reaction contained two isomeric disulpho acids, which, when converted into their soda-salts, may easily be separated from each other by treatment with alcohol. The portion of the *b* disulpho naphtholate of soda, which is soluble in alcohol, yields claret shades, whilst the portion insoluble in alcohol yields, on treatment with diazoxylol, a fine scarlet dye, which is nowise inferior to scarlet in brilliance and fastness.

Still more recently a color has been patented by Fr. Grässler, of Cannstatt, which will rival the scarlet obtained from *b* disulphonaphtholic acid, and is distinguished by its enormous tinctorial power. It is formed when amido azo benzol is treated with nitrous acid, and the diazo benzol thus formed is brought into reaction with phenoles, or their sulpho acids, *e. g.*, *b* sulphonaphtholic acid.

The other colors which have been obtained by the action of diazo compounds, etc., upon phenoles, and some of which have been patented, need not here be mentioned, as they possess little importance, and some of them are not being manufactured.

Of greater importance are three other groups of dyes, which must also rank in the azo series—the indulines, the saffranines, and methylen blue.

A compound belonging to the induline group was first obtained in 1865 by Staedel, by the action of pure aniline upon pure nitro benzol. At that time, however, this color was not yet produced on the large scale, or introduced into commerce. The first chemist who obtained it by the action of aniline upon amido azo benzol were Martius and Griess, though the reaction was more closely studied by A. W. Hofmann and Geyger. They heated amido azo benzol with muriate of aniline and alcohol to 320° F. for four or five hours, and obtained a tough, blue mass, which was first boiled in water, then dissolved in alcohol and precipitated with soda-lye. The free base thus obtained was either converted into a salt or into the sulpho acid, and the color was named by Hofmann and Geyger azo diphenyl blue. The name induline was first met with in the year 1871, and was applied by Knosp, of Stuttgart, to a blue dye which was to serve as a substitute for indigo. Subsequently Caro gave the name "indulines" to all the colors which are formed by the action of muriated amides upon amido azo compounds, with the elimination of sal-ammoniac.

Instead of heating amido azo benzol with muriate of aniline in an alcoholic solution to 320° F., these two bodies can be melted together in the dry state, when a melt of a coppery luster is obtained, which on treatment with sulphuric acid is converted direct into its corresponding sulpho acid. Latterly it has been proposed to obtain blue dyes by heating nitro benzol with aniline, with the addition of double chlorides and a temperature of 320° to 356° Fahr.

The addition of double chlorides is, however, somewhat superfluous, as chloride of zinc alone serves the same purpose, and iron filings, as Wichelhaus and Dechend have shown, give good results. If instead of amido azo benzol we employ its homologues, and use other monamines instead of muriate of aniline, we obtain a large series of indulines of the most various shades, from a pure blue to a very red violet. The indulines have acquired considerable importance, and are especially used where it is desired to produce shades resembling indigo, without the fire and the luster of so-called aniline blue.

In very close connection with the indulines rank the saffranines, but whilst the former are produced by the action of amido azo compounds upon muriatic amides, with elimination of sal-ammoniac, the saffranines are formed by the reaction of amido azo compounds with amides, attended by the liberation of hydrogen. It must, however, be noted that neither pure aniline nor paratoluidine yields saffranines; orthotoluidine must be employed.

The production of saffranine is effected either so that orthotoluidine is first treated with nitrous acid, and the amido azotoluol thus obtained is treated with an oxidizing agent, such as chromic acid, or arsenic acid. Or amido azo orthotoluol is first prepared, and is then allowed to react upon the muriate of orthotoluidine.

Saffranine dyes very beautiful pure shades, which resemble those of safflower. With the saffranines must be classed a very beautiful rose dye, Magdala red, which is formed if naphthylamine is submitted to the same treatment which has just been directed for orthotoluidine.

Magdala red is one of the most valuable but most costly dyes, and till the invention of eosine was the only one which produced fluorescence upon the fiber. In conclusion we may mention a dye whose constitution is not yet exactly known, but which, from its formation, may be considered as a thioazo benzol, corresponding to oxyazo benzol, namely, methylen blue. The first of the colors belonging to this class was prepared in 1876 by Lauth, who oxidized aromatic diamines in presence of sulphur. Thus phenylendiamine (from nitroacetanilide) yielded a very fine violet color, which can be converted into blue and green dyes by the substitution of aniline, aldehyde, etc.

The only color of this class, however, which has been introduced into practical use is methylen blue. The starting point for its manufacture is dimethylaniline. Like all the aromatic triamines this body, when treated with nitrous acid yields a nitroso compound, which on reduction passes into an amido compound. For this purpose dimethylaniline is treated with enough muriatic acid to dissolve it, and a molecule of nitrite of soda in a dilute solution is then added with refrigeration. The paranitrosodimethylaniline, which is separated out in yellow leaflets, is either directly treated with reducing agents, such as zinc, sulphureted hydrogen, sulphuret of ammonium, etc., or it is filtered off, washed repeatedly in water, and reduced with one of the above-mentioned agents.

If zinc has been used for the reduction at the conclusion of the reaction, sulphureted hydrogen or sulphuret of zinc must be added, the liquid strongly acidified with muriatic acid, and a gentle oxidizing agent, such as the perchloride of iron, must be added.

A blue solution is at once produced, but an excess of the oxidizing agent must be avoided, as otherwise red colors are formed. The blue color is precipitated from the solution by the addition of common salt and chloride of zinc, and purified by redissolving in water, and reprecipitating with the same agents.

This color, which has been patented by the Baden Aniline and Soda Company, of Ludwigshafen, is distinguished by its splendid greenish tone and its fastness, as against soap and light. It dissolves easily in water, dyes cotton without a mordant, and can be distinguished from the aniline blues by the circumstance that if boiled with an alkali it gives off dimethylamine, which may be recognized by its odor.—*Chemiker Zeitung.*

ALIZARINE CARMINE.

THIS compound, which is more correctly named sulphoalizarate of soda, is obtained by neutralizing sulphoalizaric acid with soda ash or caustic soda, dissolving this product in water, and purifying it by precipitation with common salt. As a derivative of alizarine it possesses great fastness and permanence, and is every way calculated to banish madder from its uses in woolen dyeing and printing. It is admitted, indeed, that the new azo dyes (ponceau, orange, and tropeoline) give more fiery, brilliant shades, but their fastness in fulling cannot by any means be guaranteed to the same extent as that of alizarine. The use of alizarine carmine, in addition to the love of the dyers for their old customs, had to encounter the peculiar difficulty that in order to obtain a good article, thoroughly pure, dry alizarine must be employed, otherwise brownish-red, dirty shades were obtained. But the production of the color from pure alizarine is so expensive that it cannot compete with the modern azo colors. S. Fischer, chemist at the alizarine works of Przibram & Co., has succeeded in obtaining the pure coloring matter even from the worst alizarine in the market, and has thus paved the way to its substitution for madder in woolen dyeing.—*Zeitschrift Textil-Industrie.*

CHARACTER OF ANIMAL FIBERS.

FIBERS having an animal origin do not burn, like those of the vegetable kingdom, with a continuous flame, but ignite with a sort of fusion, and exhale a nauseating odor, similar to that of burning horn, while forming a carbonized ball on the extremity of the thread. Subjected to a dry distillation, animal fibers reject some tarry composition containing carbonate of ammonia, which can be recognized by its peculiar odor and by its alkaline property of bluing litmus-paper. It is a gelatinous and albuminous compound, containing the following constituents:

Carbon	50·75
Hydrogen	7·08
Azote	17·71
Oxygen and sulphur	24·51=100·00

Wool, as it is used specially, contains a notable proportion of sulphur, which will manifest itself under proper conditions. Thus, subjected to 148° Centigrade, wool will evolve sulphur readily; also on boiling it in water.

It is the action of this sulphur which blackens the wool in high temperature, especially if brought in contact with some metallic substance, such as acetate of lead, protochloride of tin, or with any metallic surfaces. In a boiling solution of nitrate of lead, wool gets covered with sulphate of lead, and becomes instantly black. These facts are important to know for the management of the dyeing operations. Alkali can remove the sulphur in the wool. In the great carpet factory of the Gobelins all the wool yarn in hanks is subjected for twenty-four hours to a milk of lime bath, after which to a chlorhydric acid bath, followed finally by a water washing. Animal fibers are sensitive to the action of caustic alkali. These agents must not be concentrated for wool. Carbonate of soda will not injure wool, but caustic soda will. Sulphuric acid concentrated decomposes silk rapidly, also wool and hair; but diluted with water it produces some interesting effects. For instance, any wool cloth saturated in a sulphuric acid bath at 2° will suffer a considerable contraction, but will never be attacked by insects. Nitric acid produces a yellow tinge on silk, and on wool generating a yellow color called *xanthoproteic*. There is a tendency to utilize this dyeing property in the trade, but it should be rejected as injuring the chemical constitution of the fiber. The weak acids act well enough on animal fibers for dyeing. For instance, a solution of fuchsin with an alkali can dye red, while vegetable fibers could not give such a result.—*Le Jacquard.*

PRISM WITH WIDE-ANGLED APLANATICS.

THERE are several methods known of reversing negatives, but the simplest and surest is indubitably the plate taken with the help of a prism. As yet the prism is comparatively little used—first, because the proper way of using it and the service it is capable of rendering are not rightly understood; secondly, because the high price of the article renders it difficult to obtain; and, thirdly, because prisms are seldom properly constructed, their production, as Dr. A. Steinheil informs me, being attended with much greater difficulties than the production of a lens. Thus, the glass must be perfectly homogeneous, each of the three surfaces should be exactly flat, and one angle of the prism should contain 90°, and each of the other two 45°. It is further necessary that all three surfaces, A B C D, A B M N, and N M C D, should stand perfectly perpendicular between the planes, A D N and B M C —that is to say, that the prism should be free from pyramidal faults (Fig. 1). Lastly, the prism should be centered against the apparatus, its aperture should be greater than that of the lens, and should be movable centrically upon the screw of the objective, and move together with the latter on its axis.

Although I have often seen in Herr Albert's establishment

FIG. 1.

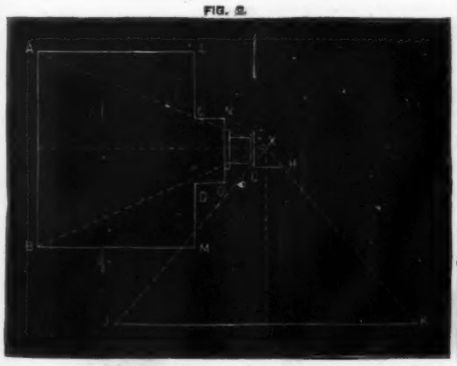
the usefulness of the prism, I thought it was only suitable for pictures with half-tones, but not for those produced by lines, since in the latter the slightest deviation from the described conditions in the construction of the prism would cause a want of sharpness, which would at once render the negative useless.

Dr. Steinheil has, he informs me, long labored to find a method of constructing a perfectly-correct prism, and some experiments with his prism which fits his wide-angled aplanatics, Nos. 26 and 27, showed me that the *direct* copies of pictures in line could not be distinguished as regards sharpness from those taken with the assistance of a prism, so that I can now recommend this way of producing reversed negatives—not only of pictures in half-tone, but also in line; and so much the more so that the diameters of the newest wide-angled aplanatics are very small, and, therefore, allow of the employment of smaller and cheaper prisms.

In placing the prism against the camera care has to be taken in two places that the latter does not impinge upon the space which ought to be left free for the passage of the light. Supposing Fig. 2 to give the horizontal section of the camera, A B L M, and of the picture, J K, then the light from that part of the object lying at J ought not to be prevented from reaching the prism by the projecting corner of the camera, M. In the same way the rays of light must pass freely from C and D, from X to A, and from X to B. This precaution is only necessary with short-focused, wide-angled aplanatics, such as Nos. 24 and 25. The higher numbers require both a greater distance from the object and a longer camera, so that this difficulty does not occur unless the camera be too wide. One may either make the front of the camera smaller or else lengthen the projection, C N D O (Fig. 2).

With regard to the placing and focusing, proceed as follows: Once for all place the camera in a horizontal position, and the easel and the focusing glass perpendicular. Measure the height of the axis of the objective from the ground, and

FIG. 2.



raise the picture (or other object) until the center is the same distance from the ground as the axis of the lens. It is well to mark this height upon the easel by a horizontal line across its breadth, and this may save future trouble. The face of the prism, G H, is then placed by the eye parallel with the object, J K. The operator then goes to the ground-glass plate at A B, and sees whether the picture is focused at the proper height—that is to say, whether the upper and under edges of the picture appear at the same distances from the upper and under edges of the ground glass (always supposing that the center of the lens is opposite the center of the ground glass). Should that *not* be the case, it is attained by turning the prism with the objective on the axis of the latter until the proper height is reached.

It has yet to be seen whether the picture is in the middle of the ground glass, measuring from the sides; if not, push the whole camera together with the slides backwards or forwards until the image appears equally distant from the right and left sides of the ground glass.

If it then appear that, though the center is sharply focused, the edges are *unequally* sharp, the fault is to be found either in the objective or the board to which the objective is fixed, or the ground glass not being perfectly perpendicular, or to the length of the camera not being perfectly parallel with the breadth of the easel on which the object is placed. If, for example, in focusing one edge of the picture sharply the camera has to be drawn further out than was required to focus the opposite edge, then the first edge of the object is more distant from the camera than the latter, and so on. By experiment in this way the easel and the apparatus can be focused exactly once for all. If the exactly-focused image be not the proper size, the distance of the long side of the camera table from the objective must be altered.

If, in consequence of the use of the prism, or of the object being too near the apparatus, a perceptible chemical focus should show itself, a simple experiment is enough to ascertain whether, after focusing the center, the ground glass should be moved nearer or further from the objective.

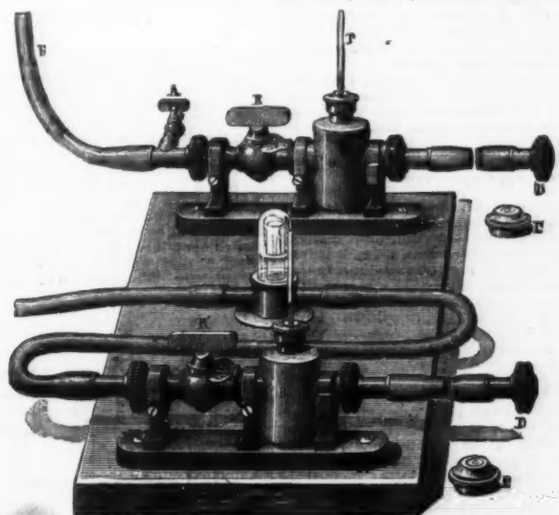
In order to be able also to take photographs without the prism, it is a great advantage to have two sets of rails crossing each other at right angles, each carrying a table set on wheels. An easel is then placed in front of one of these tables (for taking in the ordinary way), and another easel is placed against the long side of the other table (for use with the prism). The camera has then only to be transferred from one table to the other and pushed into the respective grooves in order to enable the operator to set to work at once with or without the prism, as may be desired.

With regard to the exposure: that must be increased from a fifth to a fourth when a prism is used, according to the size of the latter. The apertures of the wide-angled aplanatics are very small, and, therefore, allow of the employment of small and cheap prisms. The numbers from 24 to 27 are, when using a prism, sufficiently powerful even with the smallest stop; the higher numbers, however, under similar circumstances, require good light. Since line pictures are seldom etched larger than a page of an illustrated paper, Nos. 26 and 27 suffice in nearly all cases. With No. 26 I have produced sharp negatives 12×12 inches of pictures in line, and they have been produced up to 16 inches.—*J. Husnik, in Photo. Correspondens.*

DUMONTPALLIER & GALANTE'S REFRIGERATIVE COVER.

DUMONTPALLIER'S REFRIGERATIVE COVER.

REFRIGERATION, as well known, is often resorted to in therapeutics, and especially in cases of typhoid fever. Dr. Dumontpallier has recently had made for use in the Hôpital de la Pitié, at Paris, a new and remarkable apparatus, after designs by M. Galante. It may be described as follows: The covering is composed of rubber tubing of $\frac{1}{10}$ inch internal diameter and 26 feet in length, wound backward and forward and inclosed between two sheets of cotton cloth, which are stitched together. (Fig. 1.) The two extremities of this tube are provided with couplings to connect them with the distributing apparatus. The latter (Fig. 2) is composed of two cocks, R R', placed parallel to each other, and each connected with a metallic box, B. B'. One of the latter (D) is provided with a coupling to receive the tube carrying the water to the covering, and the other (D') has a coupling to connect it with the tube leading the water from the covering. Each of the cocks has also a coupling; to the inlet cock is fitted the tube which leads the water from the reservoir above, and to the outlet cock is fitted the tube, S, which leads the waste water to some convenient receptacle. Immediately after leaving the outlet cock, R', the water passes through a small crystal bell-glass, V, which permits the attendant to see that the passage of the water is going on regularly. Each of the two boxes, B B', is arranged to receive a thermometer, T T', the bulb of which is placed directly in the line of the current. The boxes of the distributing apparatus employed in the first application of these coverings were also arranged so as to receive a manometer in addition to the thermometer. By means of this arrangement it was possible to note both temperature and pressure at the inlet and outlet of the apparatus. The apparatus is very sensitive; for when the flow of the liquid is in the least modified by turning one of the cocks, or both of them at the same time, variations of the thermometer take place instantly. To use the apparatus the patient is placed upon it near one of its longitudinal edges, the upper part reaching his armpits; when the covering is spread over him the edge which folds over is fastened to the other edge by means of hooks and eyes. The cock, A, being then opened for an instant, the siphon, E, is set in action, the cocks, R R', are opened to their full extent, and the apparatus is in operation. It may be readily seen that this apparatus may be used for the application of heat when necessary, by simply substituting hot water for cold in the reservoir.



DISTRIBUTING APPARATUS.

CHIAN TURPENTINE.

So much interest has recently sprung up regarding this drug in consequence of its use in the treatment of cancer, and also with reference to the question of its purity as found in commerce, that a few words on its history and production may not be unacceptable to our readers. The source of Chian, Chio, or Cyprian turpentine is from a small anacardiaceous tree or shrub, the *Pistacia terebinthus* of Linnæus. Regarding the botany of the tree, we find, on the authority of the *Pharmacographia*, that the synonym of *P. terebinthus*, L., is *P. Atlantica*, Desf., *P. Palæstina*, Boiss., and *P. Cabulica*, Stocks. Under the first-named form (*P. Atlantica*) it is found in Northern Africa, where it grows to a large size, and in the Canary Islands. The form or variety known as *P. Palæstina* is found in Syria and Palestine, while *P. Cabulica* extends eastward to Beloochistan and Afghanistan. In the true form of *P. terebinthus* it is common on the islands and shores of the Mediterranean, and throughout Asia Minor. The plant varies in size from that of a shrub to a tree twenty to forty feet high. Hanbury says: "The extreme varieties certainly present great differences of habit, as any one would observe who had compared *Pistachia terebinthus* as the straggling bush which it is in Languedoc and Provence, with the noble umbrageous tree it forms in the neighborhood of Smyrna."

Regarding the history of this turpentine, it seems to have been well known to the ancients, being mentioned by Theophrastus, Dioscorides, and others. The kernels were well known to yield by expression the original oil of turpentine, a mixture of fatty and essential oils. The true primitive turpentine, which was the resinous juice of the stems and branches, was celebrated as the finest of all analogous products, and preferred both to mastic and the pinic resins. Pomet, in his "Compleat History of Druggs," published in London in 1725, at page 209, under the head of Turpentine, writes thus: "The first and dearest of all the *Turpentines* is

that of *Chio*, which flows from the Trunk and large Branches of a Tree of a moderate size, call'd the *Turpentine Tree*, which grows in the Isle of *Chio*, in *Cyprus*, *Spain*, and *France*. These Trees bear green Leaves, with Flowers and Fruit, as express'd in the Figure. As to the Fruit, they are of two kinds, the one of the Size of our Nuts, and the Shape of *Pistaches*, and the other like the Juniper Berries. But as we have no sort of Trade either with one or the other, I shall say nothing further of them, but refer the Reader to such Books as treat of them. As for that which is the *Turpentine of Chio*, it ought to be of a solid Consistence, without any kind of Taste or Smell, of a white inclining to green, and the least subject to stick in the Teeth, or to the Fingers, that is possible; and take care of the Pine-Wood *Turpentine*, which some sell for the true *Chio Turpentine;* which is no great Difficulty to find out by its strong smell, and because it sticks to the Teeth. This *Turpentine* is very little us'd in Physick because of its Dearness; but there are some curious honest Apothecaries who make use of it upon most occasions."

It is well known that at the present time Chian turpentine is very difficult to obtain pure, and it would seem that in Pomet's time the same difficulty prevailed. As it is now said that Venice turpentine forms the principal or perhaps only adulterating substance, so it would seem that the "pine-wood turpentine" referred to above was probably intended to apply to Venice turpentine; common turpentine, or Bayonne or Bordeaux turpentine being referred to later on in the same article.

True or genuine Chian turpentine is a resinous juice secreted in the bark, and is collected for commercial purposes, chiefly in the island of Scio, either from spontaneous exudations or from incisions made in the stem and branches; from this latter process the juice, of course, flows more freely; it is nevertheless a very slow process, the tapping of the trees commencing in the spring, and the collecting being continued throughout the summer. As the juice exudes it either solidifies to some extent on the trunk, or trickles down on to stones placed below to receive it. It here becomes so much condensed by the coldness of the night as to admit of being scraped off with a knife, which is done before sunrise; the trunk is also scraped in a similar manner. In the course of its passage down the trunk the turpentine carries with it many impurities in the way of dirt, pieces of bark, and other foreign substances. To free it of these impurities it is again liquefied by exposure to the sun, and passed through small basket-like strainers. The average annual yield of each tree is from eight to ten ounces, and a large tree does not give more than eleven ounces. The entire quantity annually produced in the island is said to be about 300 okes, or 850 lb. In consequence of the small quantity produced, the substance is always somewhat scarce and dear, and is seldom met with in a perfectly genuine state. The authors of the *Pharmacographia* describe the Chian turpentine, as found in commerce and believed to be genuine, as "a soft solid, becoming brittle by exposure to the air; viewed in mass it appears opaque and of a dull brown hue. If pressed while warm between two slips of glass it is seen to be transparent, of a yellowish brown, and much contaminated by various impurities in a state of fine division. It has an agreeable, mild terebinthinous odor, and very little taste. The whitish powder with which old Chian turpentine becomes covered shows no trace of crystalline structure when examined under the microscope." The same authors state that "a specimen collected by Maltass, near Smyrna, in 1858, was, after ten years, of a lightish yellow color, scarcely fluid, though perfectly transparent, nearly of the same odor as melted colophony or mastic, and without much taste. We found it readily soluble in spirit of wine, amylic alcohol, glacial acetic acid, benzol, or acetone, the solution in each case being very slightly fluorescent. The alcoholic solution reddens litmus, and is neither bitter nor acrid. Two parts of this genuine turpentine dissolved in one of acetone deviate a ray of polarized light 7° to the right in a column 50 mm. long."

In the Kew Museum is a specimen labeled Chian turpentine, presented by the late Daniel Hanbury so long ago as 1848; it is of a greenish brown color, almost solid, yet somewhat sticky; it has a slight terebinthine smell, with very little taste, but sticks to the teeth most tenaciously. This specimen, which is at least thirty-two years old, differs, as will be seen from the specimens collected by Maltass, and referred to by Daniel Hanbury, already quoted.

Notwithstanding that Chian turpentine, which, until quite recently, had become almost obsolete in medicine, is now attracting much attention, it is difficult to see how the supplies can be materially increased should a great demand arise.—*Monthly Magazine.*

THE STORAGE OF ELECTRICITY.

CAN electricity be stored up, or, to use a more figurative expression, can *electricity be bottled up*, so that it can afterward be used in such quantities as may be needed, until at length the recipient containing it is entirely exhausted? It is from this standpoint that we desire to rapidly examine a few apparatus which permit us to boldly answer, *Yes*, on condition that it be well determined in advance to what degree this storage can be effected. We will begin with M. Planté's secondary pile, for this has, up to the present, given the best practical results and furnished the largest number of applications.

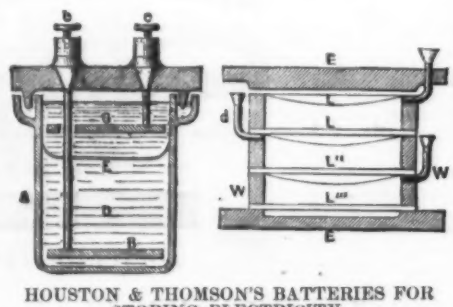
M. GASTON PLANTÉ'S SECONDARY PILE.

We need not describe here an apparatus well known to the reader, nor explain the theory of it. We will content ourselves in figuring (Fig. 1) an element of a primitive model, in which M. Planté has since substituted two narrow bands of rubber for the cloth which formerly separated the thin lead plates. Whatever be the source of electricity employed, the pile stores up the electric current, and gives it up afterwards under conditions which are often entirely different from those of the storage. 1. We represent herewith (Fig. 2) the interesting experiment which was performed by MM. Planté and Niaudet in 1875, and which is one of the most beautiful demonstrations of the *unity of the physical forces* and of their mutual transformations. A Gramme machine with a Jamin magnet transforms mechanical work into electricity, which, led into a Planté's secondary pile, becomes stored up therein. If, after charging the couple, the machine be stopped, it begins to work again in the same direction, under the action of the current produced by the secondary couple, and transforms the electric current anew into mechanical work. In this experiment, the machine revolves with less speed than it did at the moment of changing the couple, the latter acting then only as a *reservoir;* it is a *storage*. 2. If we connect a secondary couple with three or four Daniell elements, and cause this current to pass for a few hours, there will not only be a *storage* of the chemical work of the pile reaching the secondary couple in the form of electricity, but also an *accumulation;* and we shall be able to produce calorific, magnetic, and other effects, which are incomparably more powerful than those that the primitive current could furnish; although, it is true, it will be for a much shorter time. This valuable property of the secondary pile has been ably taken advantage of by M. Achard in his electric brake, and by M. Trouvé in his polyscope. We ought also to mention the experiments with electricity of high tension made by M. Planté with 800 couples charged by a few Bunsen elements only. The number of applications of secondary piles would prove immense were it not for the inconvenience that we must now

FIG. 1.—PLANTE'S SECONDARY PILE.

point out. In a well constructed couple the storage is limited by the surface of the lead plates which constitute their electrodes. Now, since the volume and weight of the elements depend on this very surface, it results that the secondary pile, as regards the maximum work that it can furnish, is relatively a heavy and cumbersome apparatus. These considerations led Messrs. Houston and Thomson to seek a new combination for an electric accumulator in which the process of storage is entirely different.

Houston and Thomson Apparatus.—These gentlemen undertook to store up the current produced by dynamo-electric machines, and to afterwards utilize it for telegraphs, bells, fire alarms, small-power domestic motors, etc. Figure 3 exhibits the principle of their storage battery, and Fig. 4 shows a series of elements arranged in tension to produce greater effects. In Fig. 3, B is a copper plate connected with the binding screw, *b*, and C is a piece of carbon connected with the binding screw, *c*. The vessel, A, containing the copper and carbon, is filled with a solution of zinc sulphate. E is a porous diaphragm separating the carbon from the zinc. If a current proceeding from a dynamo-electric machine traverses the apparatus in the direction, *b c*, the zinc sulphate will be decomposed, and metallic zinc will be deposited upon the carbon, C; while in the lower portion of the vessel, A, there will be formed a concentrated solution of copper sulphate. The duration of the deposit or of the charge



HOUSTON & THOMSON'S BATTERIES FOR STORING ELECTRICITY.

Fig. 3.—Simple Element. Fig. 4.—Element in Series.

is only limited by the quantity of zinc sulphate contained by the vessel, and by the thickness of the copper plate, B. There is thus formed a *gravity element* (analogous to the Calland element) capable of furnishing an electric current as long as the carbon is covered with zinc. It is unnecessary to say that when electricity thus stored up is being *consumed*, zinc sulphate forms again and copper is deposited anew upon the lower plate, B. Messrs. Houston and Thomson's apparatus then is in reality only a Calland pile, in which the zinc which was transformed to sulphate is regenerated, in utilizing the mechanical work furnished by the steam engine which actuates the dynamo-electric machine effecting the charge. Figure 4 represents several couples mounted in series. L, L', L'', L''' are copper plates separated by insulating rings. The interspaces are filled with a solution of zinc sulphate; and the lateral tubes, *d*, allow the liquids to dilate. The charged battery is analogous to the voltaic pile. Although the storage of electricity does not depend here on the *surface* of the plates, but on the *quantity* of the zinc sulphate, yet since the electro-motive force of each element is equal to that one Daniell element, and since the internal resistance must be great, it takes a pretty large number of elements to produce important results; and if there is a gain in the duration of the working of the pile without a renewal of the charge, it seems to us that it must be heavier and more cumbersome than a Planté's secondary pile of equal power.

M. d'Arsonval's Voltaic Condenser.—At the very time that Messrs. Houston and Thomson were combining their accumulating battery in America (Oct., 1879), M. d'Arsonval, of the College of France, was studying the same question with a view of increasing the accumulated charge in Planté's secondary pile. In the note presented to the Académie des Sciences on the 25th of January, 1880, M. d'Arsonval described his secondary couple as being composed of a zinc and a carbon plate placed in a porous vessel filled with lead granules or dross, and the whole moistened by a concentrated solution of zinc sulphate. If the couple is charged by a current passing from the carbon to the zinc, the zinc salt is electrolyzed; the zinc is deposited on the zinc plate, peroxide of lead is formed on the lead dross, and sulphuric acid remains in a free state. The deposit of the oxidizable metal, zinc, is here then unlimited, and the oxygen may accumulate in larger quantity, in the form of lead peroxide. Manganese, silver, or copper may be substituted for the lead, and also give good results, but nothing approaches the peroxide of lead adopted by M. Planté. Such is M. d'Arsonval's apparatus; and one couple containing two and one-fifth pounds of lead dross has been found capable of actuating a small Marcel Deprez motor for four hours. In mentioning still another and analogous accumulator invented by Mr. Varley, and utilized in London for a system of electrical transmission of the time, we shall have passed in review all the apparatus known to the present time which allow of the storage or accumulation of an electric current proceeding from a pile or from a machine. The best of all is without doubt Gaston Planté's secondary pile. The systems of Messrs. Houston and Thomson and D'Arsonval have not yet been put to the test, but it does not appear that they are to give better results. Must the storing up of large quantities of electricity in a small volume be for that reason considered impossible? We think not; and when we consider the immense future in reserve for such a discovery, we cannot

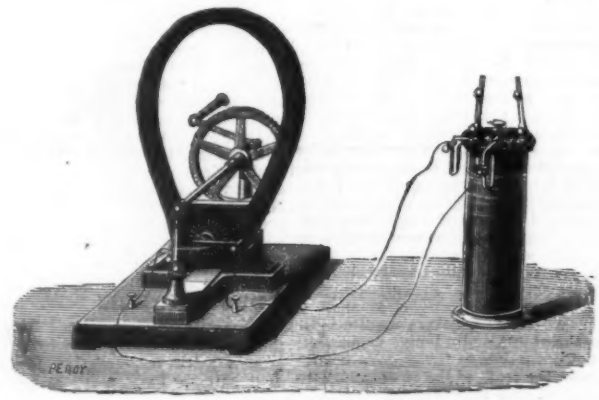


FIG. 2.—PLANTE'S SECONDARY PILE CHARGED BY A GRAMME MACHINE.

say too much to encourage experimenters to enlist themselves in the subject, although it may, perhaps, prove a long time before they achieve success.

HOW TO SAVE STRAWBERRIES IN A DRY, HOT SEASON.

THE editor of the *Rural New Yorker* tells his readers how he preserved his strawberries through a dry term, as follows:

Just as our strawberries began to ripen, one season, a very violent, hot, southern wind prevailed, which dried up the ripening fruit and began to shrivel the green. Having an abundance of clean, coarse, water meadow hay in a stack, we took from this and spread it about three inches thick over the strawberry bed, and let it lie there till the evening of the third day. We then raked it off the outside row, and found the berries filled out large and full as in cool, calm weather. We picked the ripened fruit from this row, and the next evening raked off the hay from the second row to cover the first, and thus proceeded from day to day till rain fell and the weather became cooler. Then we removed all the hay from the bed, except what was wanted to mulch under the vines, to keep the berries clean from the ground.

If the fruit of two rows were wanted, one for tea at evening and the other for breakfast next morning, we raked off two rows, leaving one uncovered during the night, as it seemed all the better for getting the dew, and the berries were fresher and finer for picking in the morning than those were in the evening.

Clean straw, we presume, would have been just as effectual as hay, and either of these, scattered thinly at night over a bed of strawberries, would preserve them from frost. It would be prudent for those who grow only a small patch of strawberries for their own eating to have a little straw or hay on hand with which to cover them in case of severe drought or frost.

JAPANESE PAPER AIR CUSHIONS.

JAPANESE paper air cushions are said to have some advantages over those made of rubber. They may be rolled into a package of smaller dimensions when not in use; they will not stick together as rubber does after it is wet, and for pillows they are better because they have no odor. Their strength is marvelous; a man weighing 160 pounds may stand upon one without bursting it. They are said to be waterproof, and to make excellent life preservers.

WIRE ROPE CABLE APPARATUS.

THE use of wire rope in place of hemp hawsers and rigging on board ship has of late years become very general, and the substitution of wire rope for chains in mining operations is equally well known. It is therefore somewhat surprising to find that, with a few exceptions, the system of working ships' anchors with chain cable is still in vogue, although the use of chains has been found impracticable for such operations as the lifting of sunken vessels. There is no doubt that the advantage possessed by a heavy chain cable of adding to the holding power of the anchor, and the facility of increasing that holding power on emergency by paying out extra length of chain, is of great value; but the holding of a ship by a large amount of dead weight lying upon the surface of the ground, as in the case of a chain cable, is an unmechanical and imperfect device. The requisite holding power is obtained by the combined action of a comparatively light anchor, which performs its work by grasping the ground, and a comparatively great weight of chain, which is of little service in proportion to its weight or in proportion to the anchor. If, however, the weight and size of the anchor be increased so as to give the greatest holding power required under any circumstances, and its attachment made by means of a comparatively light wire rope, the combined weight of wire rope cable and anchor is much less than the combined weight of chain cable and anchor, and the facility for handling is thereby much increased. Again, it may be said that steel wire rope has a weight of about one-seventh

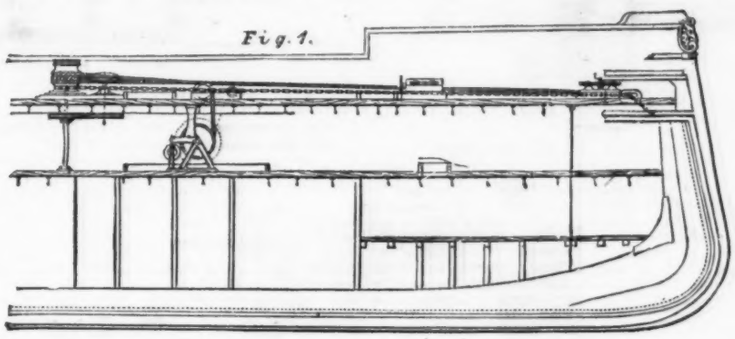
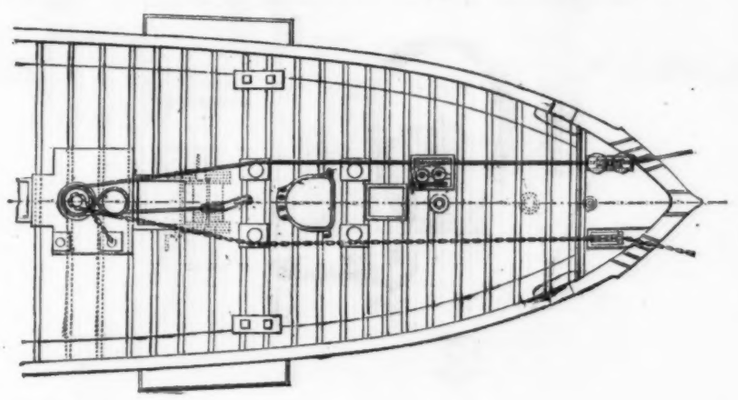


Fig. 1.



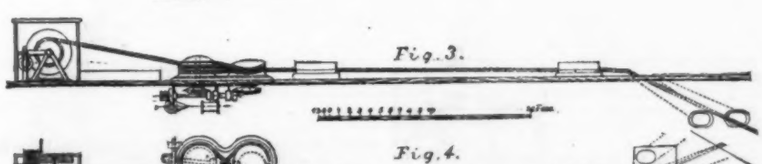


Fig. 3.

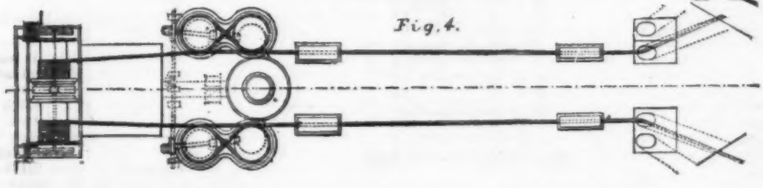


Fig. 4.

BULLIVANT'S WIRE ROPE CABLE APPARATUS.

only of that of chain cable of equal strength, without taking into account the almost perfect uniformity of strength throughout its length, which is possessed by a wire rope of 180 threads, in comparison with a chain which is liable to a defective weld in every link.

The usual method of stowing chain cable in a locker in the forward part of the ship is rendered necessary for facility of working, but it necessitates the placing of a large weight in a position in which the vessel is least water borne, and in which the strain upon her structure is therefore very great. The position of several tons of chain cable so placed may often be injurious, more especially when pitching in a seaway. On the other hand a lighter cable, stowed further aft, may be used when wire rope is applied, because from its quietude of working while running out, it could be led over any convenient length of deck and stowed amidships on a reel placed in some convenient position.

Wire rope applied as a cable having been in use satisfactorily for six years on board the Valorous, and on board two of the London, Chatham, and Dover Railway Company's channel steamers, the Admiralty decided to fit it to the Eclipse, and we annex illustrations, Figs. 1 and 2, showing the appliances for working it which have been fitted to this ship. The Eclipse is one of the earlier specimens of the corvette class that have been recently so multiplied in the navy, and the main capstan is therefore placed on the upper deck, and the reel for stowing the wire rope cable on the lower deck. The wire rope is fitted to work the anchor on the port side, is 6 in. in circumference, 150 fathoms long in one continuous length, and, weighing 43 cwt., takes a breaking strain of 90 tons. To work the anchor on the starboard side ordinary 1¾ in. chain cable 150 fathoms long, weighing 195 cwt., and with a proof strain of 47½ tons, is fitted. The stowage of the chain cable is effected in the usual way by passing it as it comes off the capstan (the lower part of which is fitted for the chain cable only) into the chain locker in the hold. The wire rope is hove up by means of the grooves on the upper part of the main capstan, and the corresponding grooves of the sister capstan placed forward, and which is made to revolve with the main capstan by means of geared wheels situated below the deck. This sister capstan is inclined at an angle to the main capstan, so that the wire rope when passed round in the form of a figure 8 may not chafe against itself, and may work without the necessity of surging. Automatically holding nippers securing the wire rope by friction while the ship is at anchor are shown a little forward of the foremast, and also in the eyes of the ship. When the anchor is being let out, the wire rope runs direct from the reel on the lower deck through the nippers and hawse pipe. The gear was made and fitted on board the Eclipse under the inspection of Mr. Flannery on behalf of Messrs. Bullivant, and we understand that on the trial the working was in every way satisfactory, giving the impression to those concerned that the use of wire rope cable with similar apparatus would become very general.

We also annex illustrations, Figs. 3 and 4, showing the apparatus for working Messrs. Bullivant's cables as designed for the Peninsular and Oriental Company's S.S. Pekin. In this case the capstans are worked by steam power, and are so arranged as to occupy very little deck room.—*Engineering.*

THE quantities of wool imported into the United States during the past six calendar years, compare as follows, in round numbers: 43, 55, 44½, 42, 48¼, and 39 million pounds, in 1874, 1875, 1876, 1877, 1878, and 1879, respectively. The average for the six years is 45,000,000 pounds per year.

THE *Advocate* of San Luis Obispo, California, says that a petrified shark has been found at the La Panza gold diggings. It weight is about 200 pounds, and it is six feet in length. Parts of the nose and tail were broken off when it was taken from the ground, and its original length was about eight feet. It is also reported that a petrified whale, some forty feet in length, is imbedded in the side of the mountain whence this relic was taken.

AN Iowa farmer estimates that the profit of raising one two-year-old shorthorn steer for market is equal to that on *eighteen* scrub steers, which have to be kept three years before they are salable.

DISTILLING AND HOISTING MACHINERY FOR SEA-GOING VESSELS.

AT a meeting of the Society of Engineers, London, a paper by Mr. Hamilton Weldon Pendred was read on the above subject.

The branch of engineering dealt with in this paper, though less important than some others, is still useful to a maritime nation, and as it possesses some features peculiar to itself, the author thinks a short description of its appliances may prove interesting to the society. At first sight the title of this paper might be taken to denote two different subjects; but such is not really the case, because, as will presently be shown, though the class of machinery with which this paper deals is usually divided into independent arrangements, still the hoisting machinery is often combined with the distilling apparatus. The author regrets that he has been unable to obtain diagrams or particulars from more than two firms besides the one with whom he himself, several years ago, acquired his own knowledge of the subject.

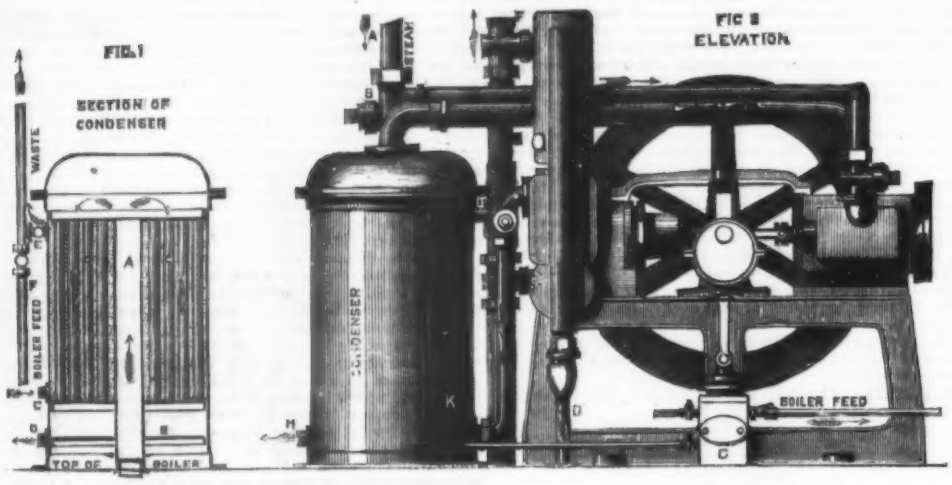
Sea water distillers either resemble those used for other purposes, consisting of a worm in a tank, or else they are ordinary multitubular surface condensers, the steam passing through the tubes, and the condensing water circulating through a tank containing them. Fig. 1 shows a Graveley's distiller, capable of yielding 80 to 100 gallons per day of ten hours, and suited for a ship of from 1,000 to 1,500 tons. This diagram illustrates the distiller combined with the cooking hearth, which has two 14 in. ovens, a hot plate, and at one end a copper or iron boiler unequally divided by a partition, the largest part for soup, etc., the other making tea. The distiller here consists of a plain square boiler, sometimes with one cross tube in it dropped into the hearth, being supported by two angle irons riveted to its sides.

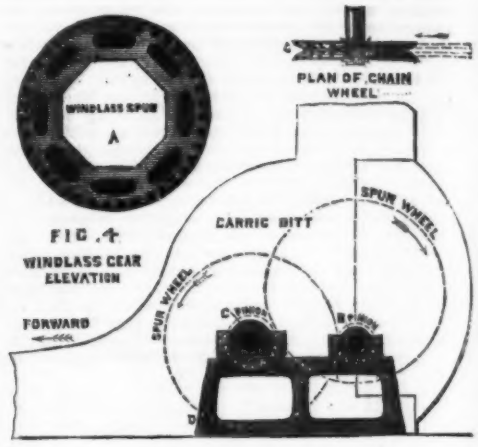
The front of the hearth is dipped down over the fire door, as shown, to admit of a water gauge. A grate and ash pit are in the hearth beneath the boiler, and the flue is taken off either inside past the oven, or outside the back to the uptake. Hence the process of cooking and distilling may go on either together or separately. In small hearths but one distiller is fitted on the boiler, but on large hearths a pair are provided. Distillers for such hearths consist of a cylinder, either of copper or galvanized iron, 10 in. to 12 in. in diameter, and 18 in. or 20 in. high. It has a tube plate carefully soldered or brazed a little way from each end. Up the center—diagram 2—is a tube, A, of three or more inches in diameter, whose lower end projects some inches below the cylinder, passing through a plate which forms the bottom of the cylinder, situated some 2 in. from the tube plate. A number of ¾ in. tubes, C C, are fixed between the tube plates, into which they are soldered or brazed; the condenser is covered with a dome top. A supply of cold water from a sea cock, where the hearth is below the water line, and where above the water line pumped for the purpose, is circulated through the cylinder outside the tubes. The steam rises from the boiler through the central tube above the upper tube plate, and then returning through the small tubes is condensed. The fresh water thus produced is received in the bottom chamber, B, and is drawn off to the store tanks by gravitation or pumping. The same stand pipe conveys away the circulating water, and also supplies the boiler, cocks, E F, being fitted to regulate both. These distillers are sometimes made separate from the hearths.

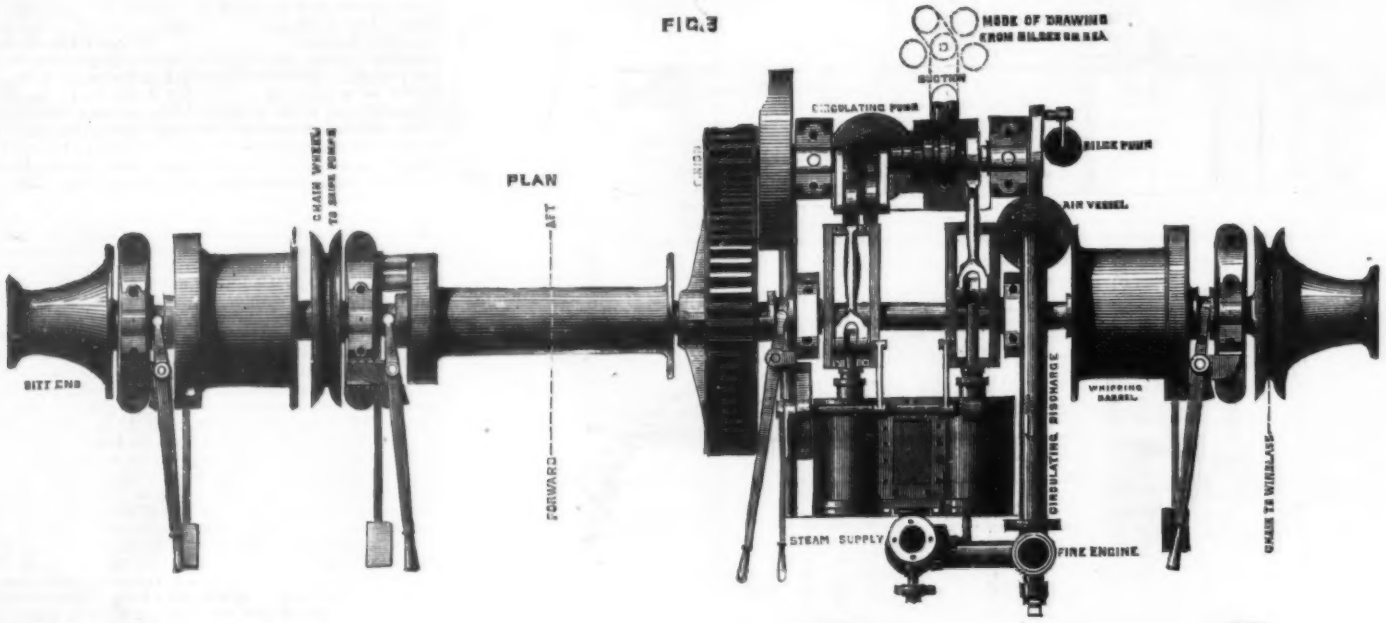
Fig. 2 illustrates a larger apparatus, consisting of a horizontal donkey engine, with a condenser at its end. The cylinder is 4 in. in diameter with a stroke of 5 in., the plunger 3 in. in diameter. This will distill from 500 to 2,000 gallons per ten hours. The condenser, K, is 2 ft. 10 in. high over the dome, with an outside diameter of 1 ft. 3 in. It contains sometimes simply a worm, but more often a cluster of ¾ in. tubes, as in the condenser last described. Steam is supplied by a return tube boiler, either flatsided or cylindrical; the flatsided boiler is usually 4 ft. in length, 4 ft. 6 in. in height, and 2 ft. 9 in. in width, with one fire tube, twelve or fourteen tubes 2⅛ in. diameter, and one steam box; the cylindrical boiler is 3 ft. 9 in. by 5 ft., with one fire tube 1 ft. 9 in. in diameter, and eighteen or twenty return tubes 2⅛ in. in diameter; it has two steam boxes 1 ft. 9 in. in diameter by 18 in. high. A glass water gauge is sometimes fitted on the lower part of one of the steam boxes; the steam does not enter it direct, but through a tube from its fellow, as some provision against priming, for, if any takes place, it will be caught in the second steam box—and its presence detected by the gauge—from which it can be blown out. The steam from the boiler passes in at A and flows to the valve chest, which is provided with a regulator of its own; at B on the condenser is a cock through which steam can be admitted direct to the condenser. The exhaust steam from the engine passes through the pipe, C, to the condenser, furnishing its quota of distilled water. The engine works the circulating pump, and the suction is shown at D, with a small air vessel. The delivery from pump to condenser is at E at the bottom of the condenser; the screw union for the out delivery is at F; the water from this union is brought into service in case of fire, for washing decks, or any other requirement. The feed pump is at G, and the fresh water runs at H.

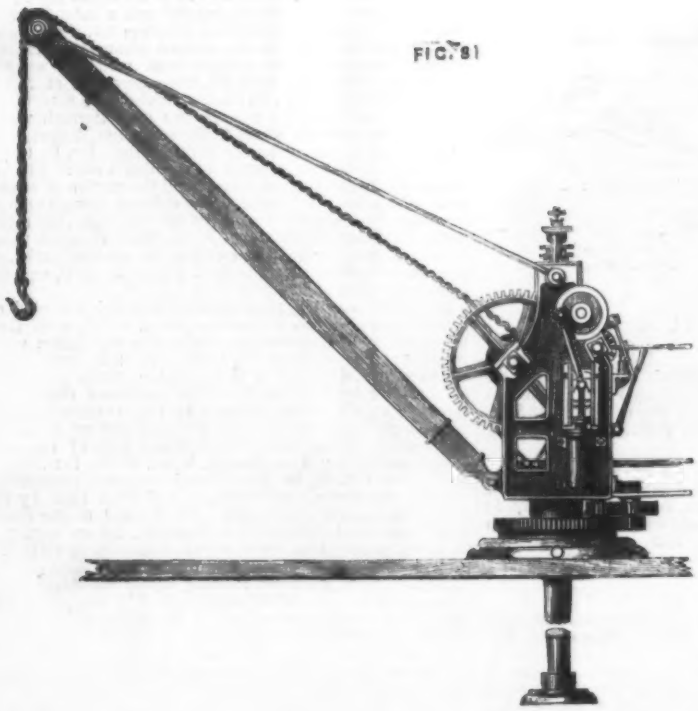
In a larger distilling apparatus, the engine is mounted on a tank containing the condensing tubes, which, with their plates, are secured to the door, and can be withdrawn when requisite. The leading dimensions of this engine are: cylinder, 7 in. diameter by 10 in. stroke; pump plunger, 4 in. diameter by 10 in. stroke. The condenser consists of eighty tubes, 3 ft. 10 in. in length by 1 in. outside diameter between plates, giving a total external surface in round numbers of 1 ft. per tube. The external size of the condenser casing is: Length, 4 ft. 9 in., width, 1 ft. 11 in., and height, 1 ft. 5½ in. The steam is caused to traverse the tubes in sets, moving twice forward and once back by deflectors in the tube plate covers. On the end of the crank shaft is mounted a pinion 7⅛ in. diameter, fifteen teeth 1⅝ in. pitch, gearing into a spur wheel of sixty-eight teeth 3½ in. wide, and a pitch diameter of 2 ft. 9⅛ in.; this is mounted on a shaft, 2⅛ in. diameter, running across the ship's deckhouse, so as to have the bitt ends clear of its sides. On this shaft is a winding barrel, of 3 ft. in extreme length, and 2 ft. 7 in. on the barrel, which is 6 in. to 7 in. in diameter. A brake and clutch gear is provided; bitt ends for sundry pulling and hauling are fitted at the ends of the shaft, the latter being supported by A frames bolted to the deck or to the coamings of the deckhouse. On one of the bitt ends is a chain wheel, and a pitch chain is led from this to the windlass to weigh the anchor, and it is also used to work the deck pumps when needed. A clutch is fitted to the spur wheel, so that if the engine is only making fresh water the main shaft spur is put out of gear with the shaft. The boiler to work this engine may be 3 ft. 9 in. in diameter, 5 ft. in length, with twenty tubes of 2¼ in. inside diameter, a fire tube of 1 ft. 7⅛ in. diameter, and a grate 2½ ft. in length

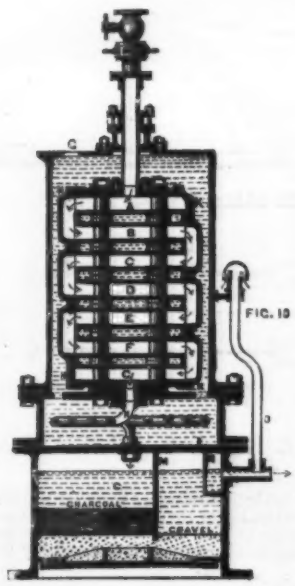
HOISTING AND SEA-WATER DISTILLING MACHINERY.

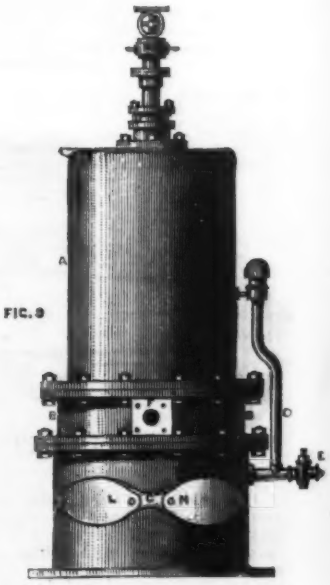


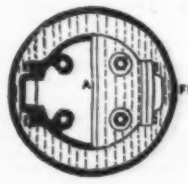


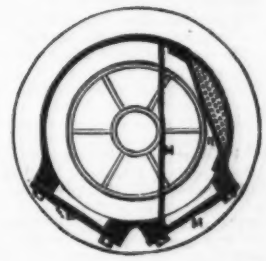












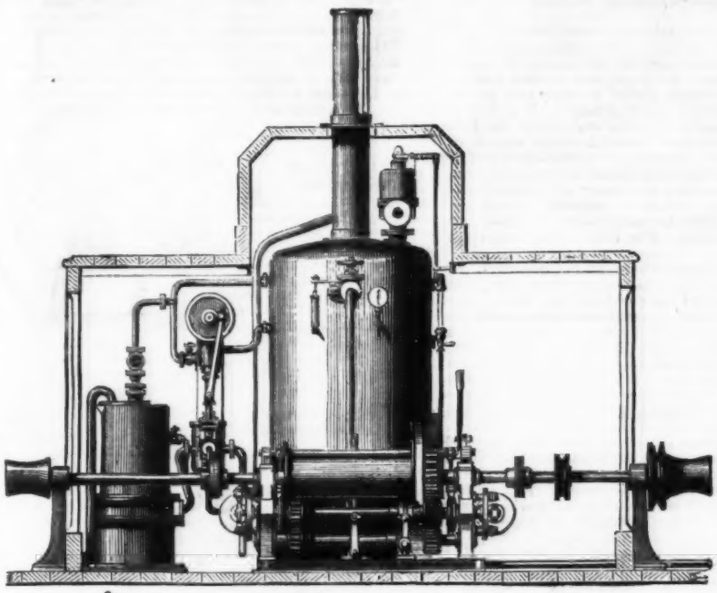
by about 4 square feet area. Assuming this to burn 20 lb. of coal per foot per hour, and to evaporate 9 lb. of water per pound of coal, it would give, neglecting waste, seventy-two gallons of fresh water per hour. The door of the condenser is secured by studs and nuts, a guide for the piston rod is provided beneath it, and a gun metal "eye lug" is bolted to the crosshead and works on the guide. The pressure of steam is usually about 45 lb. The water, of course, is filtered subquently, but the Graveley system did not include special appliances for aerating the fresh water, the patentee arguing that, as air was pumped into the boiler with the feed, it must pass off with the steam, and that the subsequent filtering, storing, and pumping into tanks also aerated it.

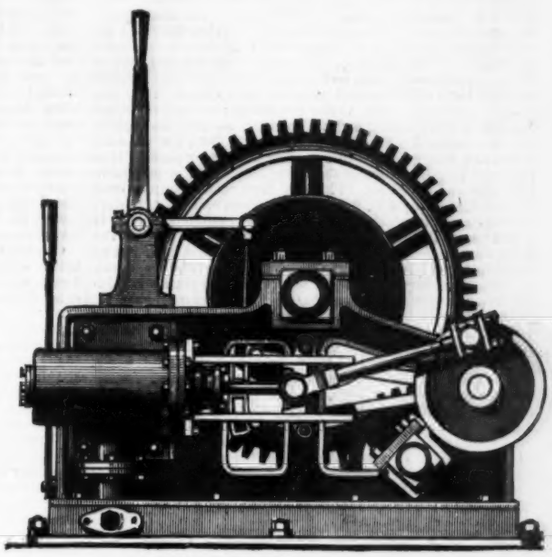
Fig. 3 illustrates another and still larger engine by Messrs. Graveley, fitted on board the Australian liner Hydaspes. Generally it is similar to the engine last described, save that it has two cylinders, a link motion, and has pumps vertically arranged at end of condenser, and the several parts are marked on the diagram.

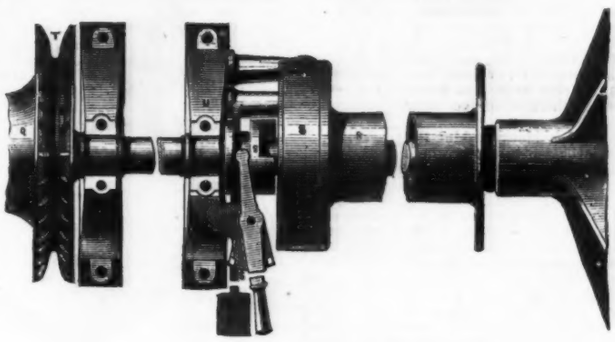
It has been said a chain was led from the chain wheel to the windlass. Fig. 4 shows a windlass such as ships of 1,500 and 2,000 tons have; a double set of powerful spur gear is fitted to it, the windlass spur being a sort of ring with an octagonal center, which embraces the end of the port side of the windlass. Iron bearings bolted to the carrick bitts carry the inner ends of the first and second motion shafts—B and O—the outer ends being borne by a frame secured to the deck. The windlass spur is 3 ft. in diameter, the pinion 9½ in. in diameter, the pitch of teeth 1¼ in., and pinion 7 in. diameter. A clutch gear, F, places the windlass under independent control; G is the chain wheel taking the power.

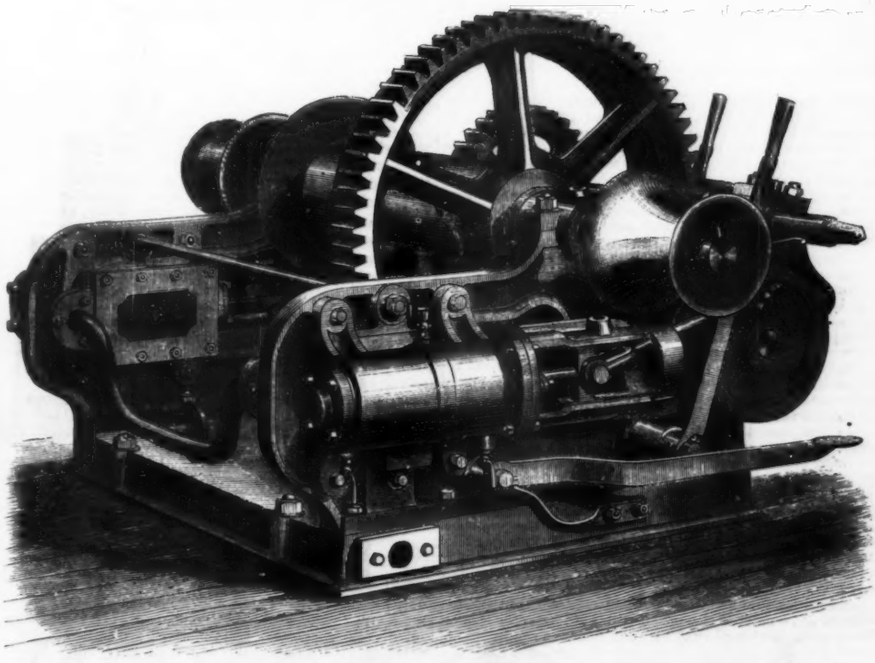
Fig. 5 illustrates a distiller by Messrs. A. Chaplin & Co., Glasgow, with a donkey circulating pump attached; the steam is admitted at K to the condenser, and at B the resulting fresh water passes into the filter, J. The steam to work the circulating pump enters at B; the waste steam can if desired be conveyed to the condenser through the pipe, C. The circulating water is pumped into the condenser at D, and escapes at E by a three-way cock, so that it can be sent overboard, or used through houses for general purposes. The distilled water, ready for use, comes out of the filter through a suitable pipe. Messrs. Chaplin's patent aerator is shown at N. It consists of a sort of cup, the top rim of which is perforated with holes. This is inclosed by a ring also perforated. The supply of air can be regulated by shifting the ring, so as to make two sets of holes more or less coincide.

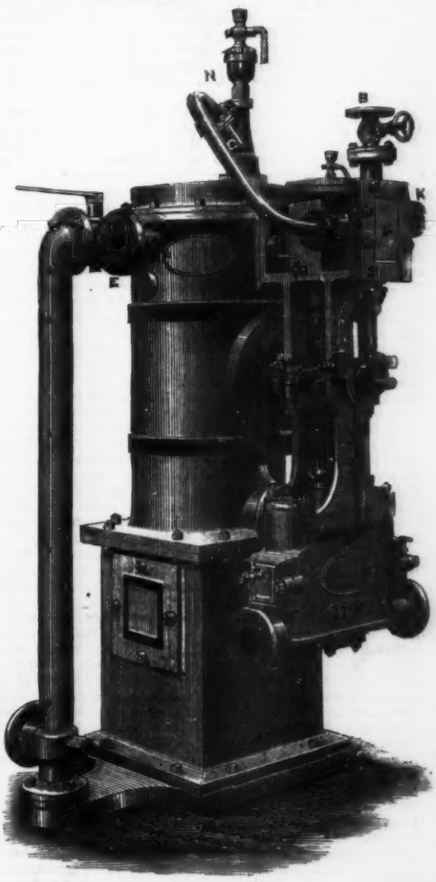
An apparatus for use on land is made by the same firm, and such an apparatus, if provided with a boiler capable of burning any vegetable substance available, would be a most valuable machine in some wild and new countries. It is well known that there are wide tracts in the Australian Bush where the water is so brackish that it is very unwholesome, either for animals or human beings. There such a machine would be invaluable. It consists simply of a vertical boiler or condenser and inclosed worm, a donkey circulating pump and a boiler feed pump to supply the boiler with water. The whole is mounted on a frame and wheels for transport. Fig. 6 illustrates Messrs. Chaplin's improved steam winch; unlike the familiar diagonal machines, it will be seen to be horizontal, and the general arrangement is so clearly shown that a detailed description is not necessary.











HOISTING AND SEA-WATER DISTILLING MACHINERY.

Messrs. Robertson, Osborne & Co. manufacture a horizontal steam winch shown in the accompanying drawings, Fig. 7. The drawings are respectively a side and a front elevation of their horizontal steam winch. They have a couple of 6 in. diameter cylinder 10 in. stroke, the lap of valve being ¾ in. and the lead ⅛ in., and are regulated by the ordinary link motion. The gearing is wheel and pinion, first power being 5 to 1, with a pitch of 1⅛ in., and the second power 2 to 1 with a pitch of 1¼ in., thus representing 10 to 1 when working double purchase, and are constructed to lift 3 tons single purchase, the power being changed by jaw clutches and the usual levers. They are provided with powerful friction brake chain barrels 12 in. diameter and 2 ft. 10 in. clear of brake wheel, warping ends and chain wheels to windlass and pumps. All shaft journals are bushed with brass and capped, so that they can be lined up and generally overhauled with ut interfering with the fixtures of the machine, connecting rods top and bottom being coupled with bolts and brasses, valve spindles passing through back of valves and secured with double nuts, the copper pipes with stop valve connecting cylinders being flanged to valve casing and not to door, so that the valves can be examined without breaking pipe joints, the exhaust steam and water formed in cylinders at starting passing into pipe cast in sole plate and then over ship's side by malleable iron pipe and coupling. The total deck space occupied over all is 4 ft. 6 in. by 6 ft. 9 in., that is, from end of cylinders to outside rim of crank disk and across cylinders. This is a little more than is taken up by the diagonal type, but the great advantage accruing not only to the winch itself but to the ship's decks from the center of piston strain on crank and center of barrel left being nearer the sole plate or holding down center amply compensates for the extra space required, the winch and decks lasting longer and giving more satisfaction to all parties. In discharging cargo this size of winch is considered equal to fifteen men, and will load or discharge 20 tons per hour of pig iron or other slung goods of this class, and bale goods, such as linen, cotton, etc., at the rate of 40 tons per hour, and requires 20 to 25 cwt. of common Scotch coal per twelve hours' constant work with a pressure of 40 lb. to 45 lb. steam, and will take about thirty men to lift anchor with, say, 45 fathoms of chain. A ship of 1,000 tons can be managed with three hands less, but speed being the great object the same number of hands are generally kept. For a 1,000 ton ship this size of winch is ample, but for over this tonnage for heaving anchor a 7 in. cylinder winch is preferable.

Fig. 8 is a side elevation of ships' steam deck cranes built by the firm, and these cranes are specially arranged for loading and discharging ships, especially where the cargo has to be loaded or discharged from lighters, a method very generally adopted in foreign ports; with a slight modification they are suitable for wharf, railway, and general purposes, in which case they can be made portable or fixed, all being arranged to hoist, lower, or turn round separately or simultaneously as desired. As per drawing they are fitted with a pair of 6 in. diameter cylinders, the gearing and general details being same as steam winch, the slewing and miter wheels being of malleable cast iron, and center column or spindle of solid forged iron extending to lower deck, where it is received by a strong step plate, the top part of column being bored out and forming a steam passage to cylinders. They are arranged for same lifts as the winches, 3 tons single purchase, and are sometimes placed in center of ship and sometimes to port or starboard. The jib is of red pine with iron sockets.

Fig. 9 is an elevation of Brown's patent fresh water condenser, A being the outside casing or dome inclosing the group of condensing boxes, B B is the worm chamber, C the filter or charcoal chamber, D the inlet aerators, and P and O the outlet aerators. Fig. 10 is a sectional elevation through A B C D and K, the combined group of boxes, A B C D E F G, and the two port doors, H H and K K, forming the connections and passages from box to box.

In using this apparatus the steam at 25 lb. to 30 lb., which generally gives the best results, enters at D the inlet aerator, and through a pipe to the series of condensing boxes, as shown by the arrows, where it is completely condensed, and then into cooling worm tinned outside and inside, where it is cooled down, and passed into the filter chamber, C, percolates down through charcoal on the one side of center plate, M, and up the gravel on the other side, and is run off to ship's tanks through a cock, E. A small test cock is provided so that the man in charge may test the water before it goes to the ship's water tanks. Connection is supplied by steam donkey pump drawing from sea, the discharge pipe being flanged to worm chamber, F; the cooling water passing from this chamber enters the dome chamber, A, when it circulates among the condenser boxes as shown by the water line, and is discharged over ship's side or coupled to hose and led to any part of the ship. These distillers are made any size, the general size being No. 1, to make 12 to 15 gallons per hour; No. 2, to make 25 to 30 gallons per hour; No. 3, to make 40 to 45 gallons per hour; and No. 4, to make 80 to 85 gallons per hour. They are passed by the Board of Trade, the allowance being from six pints to one gallon for each person, according to the climate the ship is to trade in.

Fig 20 is a view, with deck house in section, of this firm's general method of fitting the steam winch, boiler, distilling apparatus, donkey, circulating, and feed pumps, in sailing ships. The steam winch is horizontal geared, with a couple of 6 in. cylinders, and is in every respect as detailed in Fig. 7, and on board ship is set on wooden chocks, and bolted to deck, the space between the chocks beneath the winch being filled up with cement. The boiler is 8 ft. by 4 ft., with two 14 in. solid welded cross tubes, with the usual doors and all mounting complete, inclusive of Government safety valve and Salter's relief valve, pressure gauge, check valve for feed, steam, scum, and blow down cocks, as also an improved prime preventer, so that it is impossible for any brine to pass into the distiller along with the steam to be condensed. It is provided with a cast iron sole plate or ash pan bolted to deck and run round with cement, as is also the whole of deck house floor. The safety valve is arranged to blow off at 45 lb., boiler having been tested to a water pressure of 100 lb. per square inch. The steam pipe is flanged to the blow down pipe, which again is flanged to the overflow pipe from the distiller, and discharged over ship's side. The distilling apparatus, Brown's patent, as described above, is guaranteed to make from 40 to 45 gallons per hour fresh water from sea water. The combined double action circulating and single action feed steam pump is specially adapted and arranged for the purpose, the water barrels, chambers, valves, etc., being of solid brass; the ram in the circulating pump is 2¾ in. diameter, and 6 in. stroke, and draws from sea and circulates cooling water through distiller; the plunger of feed pump being 1¼ in. diameter and same stroke as the other, being driven by a stud fixed to main piston and ram rod. The cooling water is drawn from sea, and this suction pipe is generally led along deck in a covered gutter to fore peak, where it is connected to ship's side by a sea cock, and is discharged into distiller, and after doing its work overflows over ship's side. A coupling is attached to this pipe outside of deck house, so that a hose can be connected and the overflow water used for washing decks or assist in case of fire. The feed is taken by the small pump from the circulating water in distiller, partly warm; the steam is supplied to the donkey through a pipe, regulated by a wheel valve, the exhaust passing into funnel. The extension through the deck house is provided with warping ends carrying standards and couplings and chain wheels to windlass and ship pumps.

Coming now to the application and working of the foregoing machinery. For loading or discharging cargo at a quay side the fore or main yard of the vessel is braced over the quay at a convenient place, and a block fixed at the yard arm, through which a rope is rove; this is led through a snatch block to the winding barrel. If a bale is being shipped from the quay it is hoisted above the bulwarks of the vessel by the yard rope. A hatch rope rove through a block suspended between the masts is then hauled taut, and held by one or two turns round a cleat or bitt, the engine slacks off its rope, and the center of suspension is gradually shifted to the hatch rope, the bale swinging diagonally down and inboard, when the man tending the hatch rope lowers the bale into the hold. For discharging cargo the reverse is the action.

Coming to a few details of performances of machines. A boiler, 4 ft. 6 in. in diameter, of the return tube type, uses 2 cwt. of coal per hour, or 1 ton per day of ten hours. Besides this should be included ½ cwt. to get up steam and one and a half hours' standing at meal times, or eleven and a half hours in all—second quality Welsh coal being used. The Australian liner, Ethiopian, was fitted with such an engine, with a boiler 5 ft. by 3 ft. 9 in. The coal burnt was at the rate of 2¾ cwt. per working hour, and in fifty such hours 2,000 tons of cargo were shipped. On board another ship in the same line 1,800 tons were shipped in forty-seven hours. On the Yorkshire 1,345 tons of general cargo were shipped in fifty-eight working hours. The Great Victoria discharged 600 bales of wool in five hours by using a large double friction winch with cylinders 7 in. in diameter and 10 in. stroke, a boiler 7 ft. long by 4 ft. 6 in. diameter; the coal burnt was 1¾ cwt. per hour. As to cargo weights, a hogshead of sugar weighs 18 cwt.; three of these could be lifted at once, and 500 tons could thus be cleared in nine working hours by steam power. In reference to hoisting gear, the rope employed is usually a 3 in.; when all wound up there would be about one and a half layers on the barrel, which, taking the coil round the barrel to be 2 ft. on a barrel 3 ft. in length, thirty-four coils added to seventeen second coils for the half layer furnishes a total lift of 100 ft. This limit is seldom arrived at in general work, but is useful if a purchase block has to be resorted to, or under other particular circumstances. The heaviest usual load on such a rope is 35 cwt., but this, as in the case of the sugar hogsheads, is sometimes exceeded.

Referring to speeds of machinery, taking the engine, Fig. 3, as an illustration, when distilling it would work about forty to sixty revolutions per minute; when employed, as is sometimes the case, doing heavy pulling and hauling in setting up rigging or heavy work in working the ship, it would be regulated to run slowly according to requirement. Whilst weighing the anchor it is usually worked very fast, say 150 revolutions; this would rotate the main shaft say thirty-four times, which would also be the speed of the first motion shaft at the windlass, and it, gearing about 5 to 1 with the second motion, would rotate it in round numbers seven times a minute. This again gearing a pinion to the windlass spur at a ratio of about 3½ to 1, would give it two revolutions a minute. If the ship were anchored in thirty fathoms of water and had out ninety fathoms of cable, the anchor could be brought to the cathead in 30 min. with a windlass of 3 ft. in diameter, over the whelps at their largest point. Thus 30 fathoms = 540 ft. $\frac{540}{9\times2}$ = 30 min. The speed of the winding barrel of an ordinary winch is from twenty-five to thirty-five revolutions per minute, taking as an example a friction winch having a pair of cylinders 7 in. diameter by 10 in. stroke, pinion diameter or pitch circle 5½, driving a spur 36½ pitch diameter, gives a ratio of about 6½ to 1; this, at thirty revolutions of the barrel, gives a speed of pinion shaft and cranks of, say, 200 revolutions per minute, though this is often exceeded with light goods. This gives a piston speed at 1·66 per revolution of 332 ft. per minute. Such a winch would have a return tube boiler 7 ft. long, and 4 ft. 6 in. diameter. Fig. 12 shows portions of a clutch winch, and explains itself.

Turning now to distillation, allowance of water, etc., the Board of Trade allowance of water, exclusive of that used for cooking, per adult is three quarts per day.* The following is quoted from the regulations of her Majesty's transport service, to be observed in respect of all ships employed by the Admiralty as transports, hired troopships, troop freight ships, convict ships, or store ships: "1st June, 1866. Minimum allowance of distilled or filtered water per day per individual, inclusive of cooking, six pints out of the tropics and one gallon within them. To suffice for all purposes." Referring to the expense of fuel for distillation, the following may be given: In one case 30 gallons an hour, or 300 in ten hours, was produced by the consumption of 4 cwt. of coal, equaling about 7 lb. of water evaporated per pound of coal, though it must be observed that allowance for a second-class coal on the one hand, and the improbability of the amount of distilled water being anything like a close test of evaporation on the other, a higher evaporative result might have been actually obtained, but the author only gives the figures as quoted from his own notes supplied by authorities who had worked distillers at sea. In another instance 3½ cwt. of Welsh coal distilled 350 gallons of water. Then, again, on board an Australian liner the production of water per day on the voyage to Melbourne was 1,000 gallons, from thence to China 1,800 gallons, voyage home 1,400 gallons. The foregoing data, coupled with the fact that ships having a duly certified distilling apparatus on board can sail with only one-half the quantity of fresh water on board otherwise required by the Board of Trade, which is stored in tanks containing usually 300 gallons each, will enable those interested to judge for themselves of the economy of fitting a ship with a distilling apparatus.

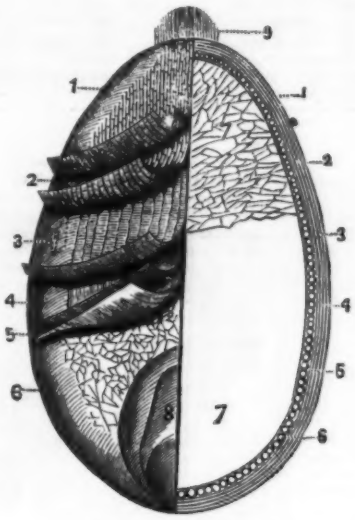
The author, in concluding his paper, will just direct attention to two points. The first is that although a small and portable apparatus for distilling water and heated by some cheap mineral oil would often be a means of saving life in cases of disaster at sea, if fitted in a ship's life or other boat, he is not aware that any such has ever been constructed, nor has the thing apparently attracted any attention; the only person who ever discussed the question with him being the Rev. Mr. Berthon, inventor of the collapsing life boat. The second point the author would refer to is as follows: All engaged in the Australian trade are often put to delay, owing to what is called the calm belt of from three to twenty miles, situate between the northern and the southern trade winds; often here a ship that has made before a rapid progress loses days waiting for any slant of wind to take her out of this region of calm. The author has heard of two liners in sight of each other at this belt for more than a day both becalmed, when one got a lucky whiff that took her to the next trade, while the other was left for two days after her. The author believes efforts have been from time to time made to utilize the steam winch or distilling engine in some way to move the ship on, and he himself designed an engine that could be disconnected from the distiller, and, with its boiler, be placed in a boat and sent ahead to tow. —*The Engineer.*

* 18 and 19 Vic., cap. 119.

WHEAT AND HOW IT SHOULD BE PREPARED.

IN our engraving, Fig. 1 on each side shows the *epicarp*, or outer coat of longitudinal cells; Fig. 2, the *mesocarp*, or inner coat of longitudinal cells; Fig. 3, the *endocarp*, or coat of transverse cells, commonly called the "cigar-coat." These three are the fruit-coats. Next to these three layers come the two seed-coats, shown by Fig. 4 and Fig. 5, and known as the *testa* and *tegmen*. Fig. 6 shows the *perisperm*, or layer of gluten sacs, and Fig. 7, *endosperm*, or irregular cells of starch and albumen bodies. At Fig. 8 the germ is shown, and at 9, the hairs of the berry.

Now, briefly, low milling, or the ordinary flat grinding process, proposes to extract from this delicate structure all its flour-making constituents by one process, proceeding to crush and press it by the application of power. One thing must be the inevitable result of such a method of procedure. If the flour (starch and albumen) is to be free from admixture with particles of the bran coatings, the pressure must be so slight as not to pulverize the coatings to any extent,



A GRAIN OF WHEAT.

and, therefore, much of the starchy and albuminoid material must be left adhering to the fragments of the bran, which is merely broken or disrupted by the light pressure. On the other hand, if pressure is applied sufficient to free all the starchy and albuminoid particles from the adhering fragments of bran, the latter must be abraded and partially pulverized, and this, while giving a large yield of flour, mingles with it particles which not only discolor it, but deteriorate its baking qualities; for it is clear that what are known as "impurities" in flour when present in any considerable amount, as they are in most flours, prevent the bread from "rising" readily. These are the two horns of the dilemma in low milling. Only a very small yield can be obtained, if, in milling, regard is paid to the structure of the wheat berry; and *per contra* quality is sacrificed if yield is obtained. Of course, the two can be compromised by a middle course; but every system of flat grinding must necessarily partake of the two results above named in some degree. Not until some process of *entirely* unbranning the wheat berry is discovered will flat grinding be able to secure both yield and quality. The delicate character of the bran on the wheat berry will probably remain unchanged for all time, and men must bring their methods of treatment to conform to it. If they regard the structure of the berry they must grind with slight pressure, or in other words grind *high;* if they regard the commercial aspects of flour-making, they must grind more than once. This is the only possible compromise that will secure quality and yield. Flat grinding must forever abrade the bran and deteriorate the flour, and high grinding is the only escape. The longer one studies the structure of the wheat berry, the more he will become convinced that the gentlest treatment it can receive is comparatively harsh, and that the flour will be deteriorated just in proportion as such treatment is harsh. High grinding, gradual reduction, or a succession of operations, is the only alternative left to the miller, and it is, besides, the only method by which all the elements of the berry can be separated from each other. It must be remembered that flat grinding incorporates into the flour everything which is "grindable," if we may be allowed the term, and this includes the germ, which tinges the flour with a yellow hue. The system of milling which permits the most perfect separation of the constituents of the wheat is the best. Flat grinding tends to mingle instead of separate these constituents, while gradual reduction tends to separate the bran, the germ, and the starchy and albuminoid bodies. The only choice the scientific miller can have is between different systems of high milling. Flat milling is precluded from his choice in the very nature of things.

What we have said of the wheat berry is, of course, relative. The harder the wheat the greater the necessity for gradual reduction, and the softer it is, the better will be the results of flat grinding. On the hardest wheats good flour

can never be made in any quantity by once grinding, and on the softest wheats, like some of those of the Southern States, flat milling is perhaps as good a way of grinding as any. The rule we have given above holds good, that *that system of milling is best which permits the best separation of the constituents of the wheat.—American Miller.*

USEFUL ITEMS FOR MILLERS.

BOLTING CLOTH HANDKERCHIEFS.

BOLTING cloth, like everything else in this world, grows old and needs doctoring. Millers have probably tried everything that will "stick," but it is well known that most mucilaginous substances do not adhere very well. I have tried about everything from ordinary paste up to Spalding's glue. The latter does very well, but the best thing is isinglass court-plaster, which is neater to handle and hangs on very well. When your cloths finally wear out, you can get out of each reel a good stock of fine handkerchiefs, which look much better than the ordinary silk handkerchiefs.

RECIPE FOR BOILER INCRUSTATION.

Incrustation of boilers? It is a hackneyed subject, I confess, but perhaps a few words may not be out of place. Everything has been tried, and there are many patent compounds. If your mill is near a slaughter-house get some cows' feet, which make an excellent preventive of scale. Irish moss will prevent the scale from adhering, and the latter can be blown out with the mud. Caustic soda has also been recommended. It would soften the scale and cause it to come off as a kind of mud, which could then be blown out, and it would not injure the boiler-plates. The only said solvent which could be used is muriatic acid, but I consider the caustic soda far preferable. A few pounds of this might be introduced when the engine is not in use, say at the end of the week, and in a few hours the whole of the scale would come away, or it might require another application. Caustic soda will also prevent the scale from forming, and is certainly one of the most harmless chemicals that could be used for the purpose.

LUBRICATORS.

The question of lubricators is one that has received much attention from mechanics, and yet the use of this or that lubricator is still a matter of habit. Petroleum certainly has some advantages over animal and vegetable oils. One serious objection attaching to animal oils is absent in petroleum. If, through the exhaust steam, some of the oils be carried into the boiler, foaming or priming is the result; but the same thing happening in the case of petroleum is a benefit rather than otherwise, as it not only does not cause foaming, but prevents incrustation or adhesion of the scale or deposit, and this, of course, aids the preservation of the boiler. It is claimed, moreover, that vegetable and animal fats and oils corrode instead of preserving metal, as is commonly believed. In course of time such oils become rancid, or acid; and as the heat of steam frees the acids from their base, they attack and destroy the metal. Petroleum and the oils derived from it are said to be entirely free from this objection. Containing no oxygen, it cannot form an acid, and therefore cannot attack the metal.

BELTING CEMENT.

The following is a recipe for making the cement for belting that I have used with success. It is excellent where there is not too much steam on the belt: Take common glue and American isinglass, equal parts; place them in a boiler and add water sufficient to just cover the whole. Let it soak ten hours, then bring the mass to a boiling heat, and add pure tannin until the whole becomes ropy, or appears like the white of eggs. Apply it warm. Buff the grain off the leather where it is to be cemented. Rub the joint surfaces solidly together. Let it dry for a few hours, and it is ready for practical use. If properly put together it will not need riveting.

FLOUR INSECTS.

Some months ago you had an article headed "What there is in Wheat." If you apply what was there said to flour you will be obliged to add another ingredient in some instances where the flour has been kept a long time. I mean the little acarian insects. A Frenchman gives the following plan of detecting the presence of these little fellows in the flour: Some flour is placed between two sheets of peper, and is thinned out by pressing it with the finger. If acarians are in the flour, they will reveal their presence by small molecules, which can be seen by the naked eye. These are then transferred by a moistened point of a microscope. To minutely study the legs and hair of the insects, glycerine and acetic acid should be used, as they increase the transparency. In order to avoid bruising the insects, a hair should be placed between the plate and cover glass. Proceeding in this way, a French scientist found that of a large number of specimens of flour, nearly all contained acarians, the numbers of which seemed to increase according to the time the flour has been exposed to air and moisture.

BENT SHAFTING.

Who is not bothered occasionally by shafts that are bent somewhat? Every miller, I suppose. A wooden shaft can be straightened by taking hard seasoned lumber and baking it in a stove or oven until it is baked as small as possible. Then it can be dovetailed into the shaft at the crookedest part. Straightening an iron shaft is a more delicate matter, but it can be done by fixing three or five points of stone or iron, so that fire will not affect them, and so that the upper surface will be in exact line. Then lay the shaft upon them and fix it firmly, so that the bend will be up. Build a fire along the shaft and heat it evenly the whole length, when a comparatively light pressure will bring it down until it touches the points previously leveled or fixed in line. Then allow it to cool, and it will be found to be straight. The shaft must not be heated so hot as to cast a scale. The following is another plan of doing the same thing: Support the shaft at the extremities, and when left free to adjust itself, the crooked or convex side will be down. Then fasten it securely at either end, so that it cannot move, and apply a lever directly under the bend. While forcing it up from below, pound from above with a heavy sledge, which will expand or lengthen the concave side, and gradually bring it straight. But, after straightening, the hammered part must not be turned off, as it would again resume its crooked shape.

CONVEYOR SHAFT.

Mr. Fredenhagen once gave in your paper directions for making a light conveyor shaft, suitable for purifiers, etc., that will bear repetition. They are as follows: Take a piece of timber of the desired length and four inches square on the end, and have it bored the whole length so as to allow an inch or inch and a quarter gas-pipe to be fitted in. Have the pipe straightened, and turned at each end for a journal, and let it project far enough to attach a pulley. Place an iron band around the wood to hold it in place, and then fasten on the conveyor flights, not quite an inch in size, and put on sheet-iron sides to the conveyor box. The whole will be but six inches across the end, box and all.—*American Miller.*

RING SPINNING.

IN the spinning of worsted and other yarns by means of the ordinary ring-and-traveler, it is the common practice to traverse the ring-rail for the purpose of building up the yarn on the bobbins or cops. This method has the disadvantage of moving the ring-and-traveler in a vertical direction to and from the eye through which the yarn passes after leaving the front rollers of the spinning frame, thereby causing the drag upon the yarn to continually vary, so much so that the yarn built on the bobbins is too tight in one part and too slack in another, and is in consequence liable to be strained or broken.

In order to remedy these defects, an arrangement has been introduced by Mr. George Salt, of the firm of Sir Titus Salt, Sons & Co., of Saltaire, which consists in fixing the ring-rail to the spindle-rail by means of pillars, so that the ring-rail is stationary. An ordinary tube and spindle is used, such as is employed in cop spinning, and the tube rests upon the lifter-plate in the usual manner, but the lifter-plate works between the spindle-rail and the ring-rail, holes being made in the lifter-plate for the pillars which support the ring-rail to pass easily through.

Another method of applying the arrangement to spinning frames, which can also be applied to finishing and roving frames, is as follows: The ring-rail is secured to the spindle-rail, as above described, but, in place of short cop-tube spindles, long spindles are used, in each of which two longitudinal grooves or key-ways opposite to each other are cut; on each of the spindles is placed a washer and collar, which rests upon the lifter-plate; each collar has keys secured in it, and will easily slide on the spindle, and at the top of each collar are secured one or two pins, which fit into corresponding holes formed in the flange of the bobbin. When the frame is in motion, the bobbins will revolve at the same rate of speed as the spindles, and the lifter-plate will slide up and down, the ring-rail remaining stationary.

The advantages of this arrangement are, first, that the drag upon the yarn is always equal, the angle between the eyes through which the yarn passes to the ring being always the same; secondly, there are no special bobbins required, as the bobbins used in this arrangement of ring-spinning are similar to those used for fly-spinning; thirdly, the lifter motion which is used to build up the yarn on the bobbins or cops in fly or cop spinning frames requires no alteration, whereas in the ordinary method of ring-spinning the lifter has to work in an opposite direction.

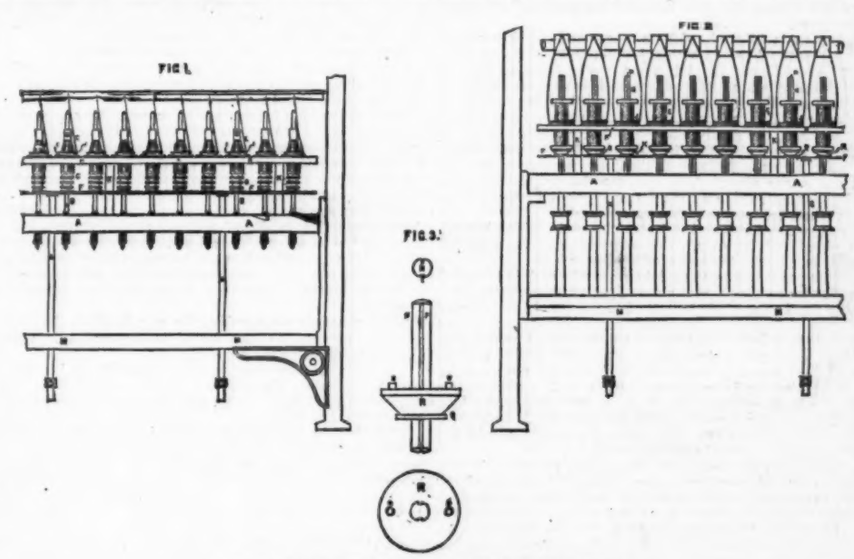
Fig. 1 is a front elevation of a portion of a ring-spinning frame.

Fig. 2 shows the improved arrangements applied to a spinning frame with long spindles, this last arrangement being also applicable to finishing and roving frames.

Fig. 3 shows details of a spindle as arranged according to the present invention.

In Fig. 1 the spindle-rail is indicated by A A; in this rail the spindles, B, B, are fixed in the ordinary manner, and the latter revolve and slide the cop-tubes, C, C; on the cop-tubes are placed the bobbins, D, D, which revolve at the same rate of speed as the tubes, C, C. The yarn which is being wound on to the bobbins is shown at E, E, and the lifter-plate, F F, on which the tubes, C, C, rest, is worked in a vertical direction by the lifter-spindles, G, G, which are connected to the lifter in the same manner as in ordinary cop-spinning frames. The ring-rail, H H, to which the rings, I, I, with their travelers, J, J, are fixed, is held rigid and stationary by the pillars, K, K, which are also secured to the spindle-rail, A A. The eye-rail or wire-board, L L, through which the yarn passes from the front rollers (not shown in the figures) to the bobbins, D, is of ordinary construction. The step-rail, M M, is used as a guide for the lifter spindles, G, G, to pass through, and as a stay for the frame ends.

When applying the arrangement to spinning frames fitted with long spindles, and for finishing and roving, the ring-rail, H H, is secured as shown in Fig. 2 and the lifter-plate, F, F, is worked in the ordinary way, but the spindles, N, N, are made with two grooves or key-ways, P, cut opposite to each other. On each spindle is placed a washer, Q, which rests upon the lifter-plate, F F, and on the washers is placed a collar, R, having two keys which fit into the longitudinal grooves, P; the pins, S, S (Fig. 3), secured in the collar, R, fit into corresponding holes in the flange of the bobbin, so that the bobbins revolve at the same rate of speed as the spindles, and travel through the stationary ring-rail as above described.—*Universal Engineer.*



RING SPINNING IMPLEMENTS.

[Continued from SUPPLEMENT 233, page 3718.]

CHAMELEONS.

By PROFESSOR J. REAY GREENE, B.A., M.D., F.L.S., F.Z.S., etc.

WHEN not pursuing its prey the Chameleon maintains an almost corpse-like stillness. But its rapidly shifting eyes, moving independently of each other and often glancing in different directions, contribute much more than the creature's changes of color to enhance the strange weirdness of its aspect. Nor is this effect lessened, when it begins to stir, by its very stealthy and deliberate movements. Having sufficiently neared its prey, it pauses while it takes aim; and the body in general is motionless as the tongue escapes from its mouth with incredible velocity.

These strong contrasts of motion and rest, its painfully gaunt form unrelieved by any amount of gluttony, and its marvelous fitness to do the work of its life are the chief sources of our interest in the Chameleon. As a fly-catching machine it is perfect. What seems defects in its organization are truly the reverse. We repeat that the Chameleon's feebleness, rightly understood, must be regarded as operating in its favor. If it moved its legs quicker, its eyes or its tongue slower, it could not secure its prey with such fatal accuracy. We have seen ten minutes elapse between the first sighting and the final capture of a large bluebottle-fly by a captive Chameleon. During this protracted interval, as the animal with persistent caution stole gradually upon its victim, alternately raising and putting down one leg after another, no doubt of its ultimate success could be entertained.

In Merrem's arrangement of lizards the Chameleons constitute a group of *Prudentia*, on account of their grasping limbs. They are more frequently named *Vermilingues* or *Rhiptiglossi*, from their peculiar tongue.

The Chameleon's skin is, for the most part, not scaly in the ordinary sense, but rather soft and extensible. Small distinct tubercles of uniform size serve to strengthen it. The dorsal ridge is minutely serrated. Along this and the ventral ridge, as well as on the head and limbs, the tubercles are closer, flatter, and more scale-like.

The common use at all times of the word Chameleon in metaphor, its application by the ancients to certain plants, and by the moderns to a well-known mineral, show that the changes of color to which it is subject have attracted much more attention than its other peculiarities. In this respect, however, the Chameleon enjoys a pre-eminence which it scarcely deserves. For many lizards and other animals possess the same property, if not in the same degree. We may mention more particularly the cuttlefishes among invertebrates, and among true fishes the sticklebacks. A large number of similar instances might be cited.

We must here distinguish changes due to the presence of special pigment-cells, or "chromatophores," from diversities of color depending on true variation, sex, age, seasons of the year (notably in animals which moult), and the more transient results of altered states of the circulation, as in blushing or the reverse.

When chromatophores are present they are affected by physical influences, such as light, heat, contact of foreign bodies, and other varying external conditions; they are also subservient to emotional causes.

Chromatophores occur in several reptiles, batrachians, fishes, mollusks, crustaceans, and insects. They are deep-seated tegumentary cells which contain a dark pigment. According as they approach or recede from the surface of the skin, they modify the tints of the semi-transparent more external layers.

But how is this movement effected? It is not the result of muscular action, as some have supposed, for the skin has no muscles which can thus rearrange its pigment-cells. We hold the opinion of Leydig, who is supported by Von Siebold, that the chromatophores are themselves capable of contraction. The contractile substance would seem to be situate chiefly in their outer portions. The pigment itself is not diffused, but granular. It has no inherent contractility, however it may be disposed in relation to the true contractile substance.*

That the nervous system governs the movements of the chromatophores may be admitted. Bert, who has made experiments in Chameleons to settle this question, asserts the

* Harting has made the surprising statement that the peculiar pigment-cells of a cuttle-fish (*Loligo vulgaris*) have a colored wall inclosing a cavity filled with soft contractile protoplasm.

presence of two distinct sets of nerves, by which the alternating changes of the chromatophores are directly excited. He even assigns to these nerves their appropriate centers. But these experiments should be repeated. Perhaps they prove too much, for we need more positive evidence to disprove the hypothesis that the retrocession of the chromatophores is essentially a passive movement.

The opposite sides of the same Chameleon may be differently colored. Dead and sickly Chameleons are paler than others. So, likewise, are Chameleons kept in darkness. We cannot follow Bedriaga in his efforts to describe the dark tints (whether temporary or permanent) of these and other lizards to the sole influence of light, acting directly on the deeper cells of the skin and causing them to assume a more superficial position. Leydig has sufficiently disposed of this explanation. Our space does not allow us to cite the details of his very interesting and convincing observations.

All the actions of the Chameleon, except during the breeding season, tend to the procuring of food. The tongue is the prehensile organ used for this purpose. A Chameleon projecting its tongue may truly be designated the entelechy, or perfection, of the living animal.

When not thus employed, the tongue lies concealed in a special depression of the floor of the mouth. We must therefore distinguish its retracted from its extended condition. Brehm rightly indicates a third or intermediate phase, in which the tongue, previous to being ejaculated, is loosened and pointed towards its prey.

The tongue consists of two principal regions, a proximal and a distal. The former, or so-called "worm," is exceedingly extensile, but is much shortened in the retracted condition. The latter is terminal and club-shaped, preserving in its alternate states nearly the same dimensions. Milne-Edwards distinguishes a basal division, behind the worm, which may rather be said to consist of the hyoid muscles. These are very complicated. A full technical description of them would be out of place in the present paper.

The worm is not inaptly so termed, whether we view it in its retracted or extended state. In the former, it is much corrugated transversely, and is about as long as the "club," the whole tongue having an average length of an inch and a half. When fully stretched out, to an extent of some five inches, the worm is nearly smooth. A trifling fold still distinguishes it from the club, into which it passes by a gradual enlargement.

The club is bilobed, with an upper and a lower "lip." The extremity of the latter projects in front of the tongue, and its ventral aspect is plainly more elevated than that of the club lying behind it, from which it is marked off by an indentation. The upper lip, or "dome" of Mr. Salter, is itself shaped like a tongue in miniature, having a raised dorsal surface, the gently narrowed hinder portion of which descends rather abruptly to join the club proper. From this part to its anterior end the dome is more than half as long as the club. The shallow fissure between the two lips is dilated into a funnel-shaped cleft by their separation when the tongue is thrown forwards.

A glutinous secretion lubricates the club, which has minute glands of its own. But other glands moisten the tongue, as it lies in the recess of the lower jaw.

The tongue is a tube, the axial cavity of which is occupied by a slender cartilage, the glosso-hyal or ento-glossal, supporting nearly the whole length of the organ in its state of rest. The soft parts of the tongue consist of (1) epithelium; (2) pigmentary and submucous tissue separated by loose interstitial connective tissue from a fibrous sheath, and (3) longitudinal muscles, besides nerves, glands, and vessels. There is also an inner fibrous sheath with a smooth free surface, which glides over the glosso-hyal cartilage. The club has peculiar muscles, well described by Zaglas. The existence of minute smooth intrinsic muscles within the substance of the worm is still disputed.

It is probable that four sets of muscles successively promote the extension of the tongue, namely, (1) certain of the hyoid muscles, (2) the longitudinal muscles, (3) the smooth muscular fibers of the worm, and (4) the muscles of the club. Other hyoid muscles retract it. To the same muscles, however, different uses have been assigned by different observers. It has even been conjectured that the extended condition should be regarded as the more passive state of the organ. Others consider the protrusion of the tongue as a sort of erection; but such vascular turgescence must here play quite a subordinate part. Nor can the mere elasticity of the sheath effect much. We cannot here discuss these diverse explanations. The whole subject demands fresh researches. As Milne-Edwards has well said, the mechanism of this movement has not yet been explained in a satisfactory manner.

Though very carefully aimed, the tongue darts from the mouth as if its previous training thoroughly suited its own spontaneous energy. Perrault erroneously supposed that it was coughed out by air driven into it from the lungs. Bibron has graphically compared its expulsion to the act of spitting. Pagenstecher, on one occasion, saw a Chameleon eject its tongue with such force that the animal lost its hold in consequence, and tumbled off the tree on which it was resting.

From the tongue of the Chameleon we naturally pass to its eyes. For by these the prey is first perceived, and if we could trace the intermediate changes which take place in the nervous system we should then be in a position to understand how the tongue receives the orders to do its work.

The eyes are relatively large. Each as a whole is nearly spherical, the equatorial slightly exceeding the axial diameter (8½: 8 millimeters). But what may be termed the morphological equator of the eye, corresponding to the border of the sclerotic in front of the retina where the corpus ciliare and ciliary muscle are placed, is of no great extent. It gently rounds off into the region behind it, in a manner not conspicuous externally. The anterior portion of the eye is more strongly prominent.

The basal moiety of the sclerotic is exceptionally small. It is constituted by a round cartilaginous disk overlaid by a layer prolonged from the much larger fibrous portion. This disk does not reach the optic nerve. The anterior zone of the fibrous moiety, surrounding the lens, is strengthened by a ring of peculiarly curved thin bony plates which are sunk in its substance.

The choroid is very thin, but is notably thickened posteriorly throughout the region subtending the yellow spot. A somewhat conical projecting pecten, about a millimeter in depth, covers the place of entrance of the optic nerve. The corpus ciliare is broader than the iris and the pupil taken together. The muscles of the iris are extensive, as in birds; from the marginal sphincter fibers stretch backward towards the ciliary border, and behind these is a less powerful radial dilatator. The iris of the dead Chameleon is half as wide as the pupil. It lies in complete contact with the lens. Its brilliant anterior surface has a dark background. Insignificant prominences replace the ciliary processes, anterior to which occur exceedingly weak meridional flutings. On the outer side of the corpus ciliare the ciliary muscle (*tensor chorioideæ* of Brücke) arises from a conspicuous lamina of connective tissue, which reflects light and serves to support the cornea. The relative diameter of the cornea is less than in any other vertebrates except the turtles.

The anterior chamber of the eye, containing the aqueous humor, is remarkable for its slight depth.

The lens, on the other hand, is strongly convex.

But of all parts of the eye the retina is the most worthy of study, because of its large yellow spot. This, the region of exact vision, occupies the hinder pole of the retinal concave, and displays a central pit surrounded by a far extending zone, throughout which the retina is much thicker and beautifully modified in its minute structure. Especially modified is the so-called percipient layer.

The corresponding region of the human eye shows this layer to be furnished in the fovea proper with cones only. The yellow spot around it has many cones and but few rods, while in the remainder of the retina the rods greatly outnumber the isolated cones. Of two equal retinal areas that which has more numerous (and therefore more slender) cones permits more precise visual discrimination. Heinrich Müller dwells on the following points of difference between the percipient layer of the Chameleon and that of man:

1. The Chameleon has no rods, but cones only.
2. The foveal cones in the Chameleon are remarkably thinner than in man.
3. The (absolute) length of the foveal cones in the Chameleon, notwithstanding its smaller eyes, is more conspicuous than in man.
4. The difference in the diameter of the cones, both in the peripheral and central regions of the retina, is greater in the Chameleon.
5. The region corresponding to the human yellow spot is more extensive in the Chameleon.

On the whole, sums up H. Müller, if we compare the human eye with that of the Chameleon, the reptile has altogether the advantage.

Outside the bulb of the eye, but within the large though shallow orbit, the optic nerve, which is here remarkably long, makes a complex loop. It bends downwards, outwards, and again upwards (or even inwards, in certain positions of the eye), previous to its insertion.

Retractor muscles of the eye appear to be absent.

There is a large Harderian gland at the anterior angle of the eye, although the nictitating membrane is rudimentary. The lachrymal gland is small.

The two eyelids of man are represented by one great circular curtain, drawn over nearly the whole periphery of the protruding bulbus and circumscribing a small central orifice. A bony plate lies in the lower moiety of this lid. Beneath the skin of the lid, which resembles that of the general surface, is spread an extensive orbicularis muscle.

The free surface of the conjunctiva, very distinct from the adjoining lid, is also of unusual extent, reaching as far back as the equator of the bulb. The extraordinary mobility of the Chameleon's eyes, in which it far surpasses all other vertebrates, is much aided by this arrangement, to which the curious curvature of the long optic nerve also contributes.

Thus, whether we consider the eye itself or its appendages, we have to do with an apparatus which is without parallel in the animal kingdom.

The male of the common Chameleon differs but slightly from the female. He is known by his occipital crest, which is longer and higher, and by the shorter fold occupying the region of the neck.

The female lays a heap of sphæroidal eggs, grayish white in tint, with calcareous, very porous shells. Oviposition has been observed only in captivity. No one seems to have witnessed the hatching of the eggs, or to have determined the period of incubation. Brehm found that many females, "even the strongest and healthiest," die before or soon after the breeding season is over. He gives an interesting extract from Vallisneri, who noticed that one of his captive Chameleons was for some days restless on her perch. Thence she slowly descended, moved about for a while, and at length paused in a corner of the floor of her box, which was covered with hard earth. In this she made a hole with one of her forepaws. For two days she worked, digging a pit about ten centimeters wide and fifteen deep. In this pit she now laid more than thirty eggs, and then, as she retired, pushed back the earth with her hind feet, treating the heap of eggs as cats do their dung. Finally, she covered the heap with straw, dried twigs, and withered leaves.

That the Chameleon bears living young is often untruly said. It is well known that in many so-called viviparous reptiles the egg is detained in the oviduct and there developed. What is thus normal in these may possibly occur as a rare (or pathological) exception in the Chameleon. But full proof is wanting.—*Popular Science Review.*

SNAKES.

RECENTLY the theater of the London Institution was densely crowded with members and visitors assembled to listen to a lecture by Mr. J. Ruskin, entitled "A Caution to Snakes." Dr. Warren De La Rue, F.R.S., President of the institution, was in the chair. Alluding to the fact that Professor Huxley had opened the lectures for the season in that theater with one on "Snakes," Mr. Ruskin said he trusted the seeming antagonism between himself and that distinguished man, to whose genius as well as to that of Mr. Darwin he paid a high tribute of respect, would not be misunderstood. The subject was appropriate to St. Patrick's Day. Pointing to his diagrams, he singled out one representing the constellation Draco as enlarged from a common celestial globe, to show the smallness of the assistance hitherto accepted by modern astronomy from modern zoology. Mr. A. Severn had drawn the head of the same, giving a general type of modern dragon idealism, with which was contrasted a Greek ideal, being the Lernæan Hydra, drawn by Mr. Ruskin himself from a coin of Phæstus. The lecturer observed that the Greek who struck that coin had seen in mental vision the seven-headed serpent slain by Herakles. The names of the snake tribe in the great languages were then vividly explained and illustrated. In Greek, *ophis* meant the "seeing" creature, especially one that sees all around it; and *drakon*, one that looks well into a thing or person. In Latin, *anguis* was the strangler; *serpens*, the winding creature; *coluber*, the coiling animal. In our own Saxon, the "snake" meant the crawling creature; "adder" denoted the groveler. In illustration of the Greek terms Mr. Ruskin remarked that, when he sketched from life the head of the rattlesnake threatening, the creature seemed to be looking at him out of the back of its head. The lecturer then proceeded to speak of the nature of snakes. It was important to know what genus, or, as he would say, gens, and species meant. The former was accordingly defined as meaning race, and the latter as equivalent to family. Between such races and families there were always connecting links, for between even the eagle and the trout the penguin looked like a link, just as the bat was between the swallow and the field mouse. The genera or races of snakes seemed to be four. There was the lizard which had dropped its legs; the duck which had dropped its wings, the fish which had dropped its fins; lastly, some sort of honeysuckle with a bend stuck on. These classes were spoken of in detail. Under the last head Mr. Ruskin referred to snapdragon and other flowers, the analogy between which and snakes had been observed for ages; also to carnivorous plants, to climbers, and to creepers, such as honeysuckle, woodbine, and ivy. The principal diagram was a drawing by Mr. A. Severn of part of Giott's sculpture of the Creation of Eve, whose danger is foretold by the twining ivy above. Another diagram was a sketch of the cranberry blossom by the lecturer. In concluding, Mr. Ruskin, politely crediting his audience with all such wisdom of the serpent as was desirable, advised them not to eat their meat before tasting it, like the boa which swallowed its blanket. On the other hand, they might do worse than stick to wholesome intellectual food with the tenacity of the same animal, which never lets go its prey until it has enveloped it as in a sack.

THE RAT KING.

THE name of "rat king" is given to a number of rats that have entangled their tails to such an extent that it is absolutely impossible for one rat to separate itself from the others, and must thus depend in its helpless condition entirely upon the liberated rats for nourishment. The well known German artist, Ludwig Beckmann, had occasion to examine a rat king that had been killed just previously, and made a careful sketch of the same, represented on the next page, for which we are indebted to the *Leipziger Illustrirte Zeitung*. The rat king was taken to a taxidermist, who removed the conglomerate of hair, tallow, clay, etc., that surrounded the knot of tails, so as to enable several scientific gentlemen to make a careful examination. The tails were only entangled, but to such an extent that it was absolutely impossible to move certain parts, but careful examination showed that none of the tails had grown together. Mr. Beckmann states that these rat kings come into existence in the following manner: The old rat lies upon the tails of the young rats, and throws the latter about with her snout, and thus produces the first knot, and as the young rats are helpless and do not move about much, a small quantity of clay or mud is sufficient to keep the tails united, and as that part of the rat grows very rapidly, the tails will be inseparably entangled in a short time. The other rats never desert the rat-kind, but always supply them with sufficient food, of which the above rat king was a very good proof, as all the members were fullgrown and fat.

ELEPHANT BATTERY CROSSING THE CABUL RIVER.

THE picture opposite shows the passage of the Third Company of the Royal Artillery across the Cabul River on their return from the Lughman Valley Expedition. Two guns of this efficient battery, under Major Magenis and Lieut. Granet, were mounted on elephants. The horses and drivers followed in rear, so that the guns could be horsed when the nature of the ground permitted. The elephants showed their proverbial sagacity by the careful manner in which they picked their steps across the rocky bed of this treacherous flood, where a month before five unfortunate troopers of the Carbineers had found a watery grave. The gun, carriage, limber, and eight ammunition boxes are hoisted on to the elephants' backs by fourteen stalwart gunners, the whole operation occupying about six minutes. When the guns of a field battery are mounted on elephants the reserve ammunition is carried in boxes on camels.—*London Graphic.*

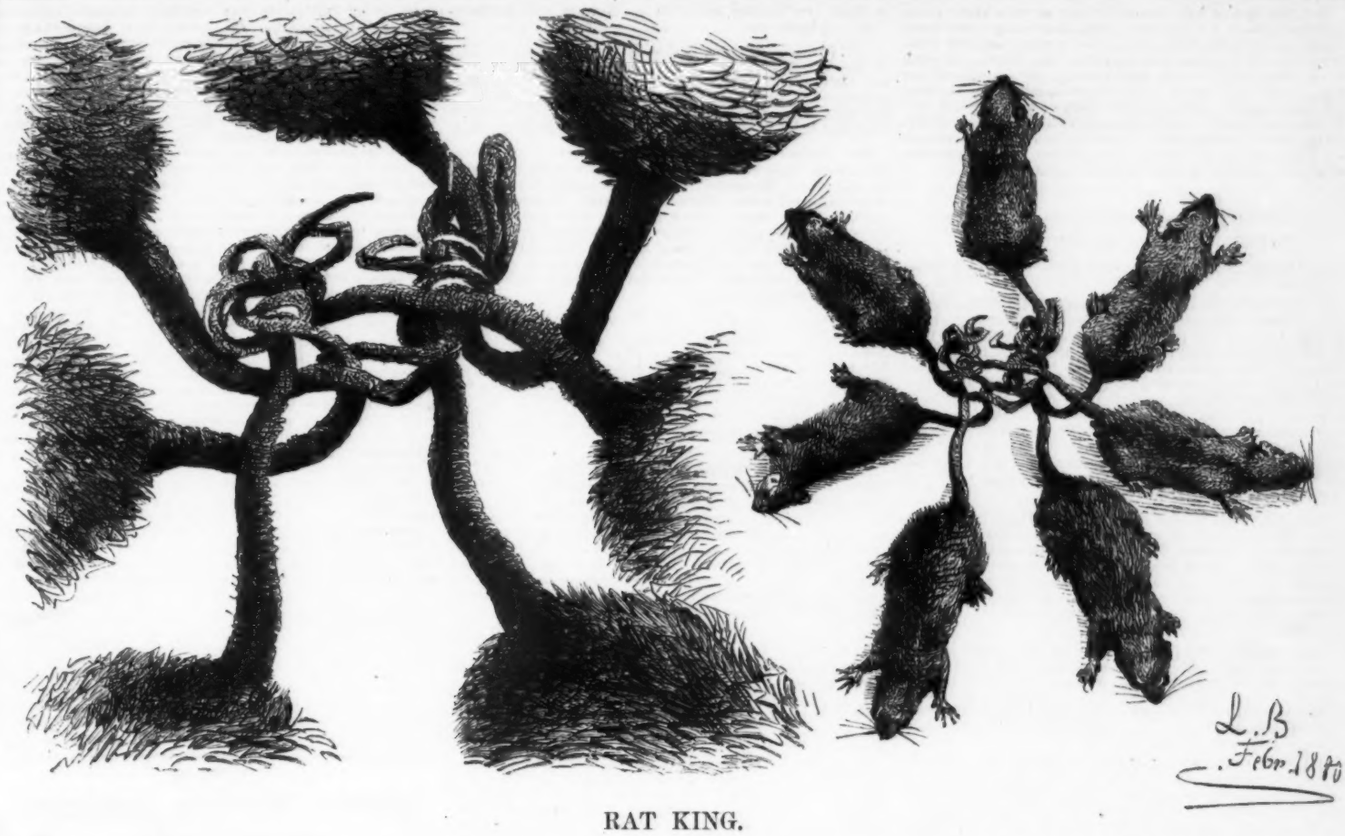
SPARS.

FROM an interesting article on masts, in the *Timber Trades Journal*, we compile the following: The forests of England have given us a great store of shipbuilding wood in the form of oak; but whether they ever produced fir trees suitable for conversion into masts is a question of very grave doubt. We have, on the other hand, evidence of masts and spars being largely imported into England in the middle ages, and we have copies of bills of entry before us which reach back into the past for nearly five hundred years. The growth in the size of the ships of France and England, more especially in the navy, led the merchants to search about for gigantic trees. The masts of Norway could not, in redwood, be supplied of larger size than 18 inches at the butt, and of these the supply was very limited. Hence this shipment was understood to be a small one, and the "Norway mast" is still the trade term for small masts. Dantzic and Riga took up the trade, and furnished masts of 18 inches to 25 inches in diameter.

During the last half century a great change has come over the spirit of the mast trade; the high prices and ready sale of those from Riga fostered enterprise on the part of the English people whose lot had been cast in the forests of the New World. Log by log the gigantic trees of Canada, the United States, and Australia, were introduced to the English dockyards, and little by little the old trade of Riga has been undermined, until, as in the present day, the shipbuilders of this great country are practically independent of the old Baltic ports.

In the "fresh fields and pastures new," thrown open to the mast trade, the fir, from its height, its straightness, and its lightness, in one variety or other, is rigidly adhered to. Roughly speaking they may be classed under five heads, viz.: 1. Quebec yellow pine. 2. Quebec red pine. 3. United States pitch pine. 4. Oregon pine. 5. Kaurie pine.

The yellow pine has been fairly used and tried; but being soft, easily broken, prone to decay at the level of the deck, and, what is of the greatest consideration, very costly, it is now but sparingly used. The red pine, although a fine grown tree, is rarely sufficiently straight for the purpose of masts, and in consequence is but little used. The pitch pine may to-day be termed the true "mast tree;" it has all the requisite qualities for this purpose, but its weight is a great drawback, and it is not considered a very durable wood. These objections are more than compensated for by its cheap-



RAT KING.

ness, and the clean sound character of the wood; and hence in almost every shipyard in England it is more largely used than any other pine.

The Oregon or Douglas pine ranks, from its great size, as the first of the mast trees. It is grown in the forests of northwestern America, a quarter of the new continent that has shown us examples of colossal trees, the like of which was previously unknown to the world. These masts are sent to us in a hewed form, faultless on every point. This wood, from the cost of transit, cannot be brought into competition with other shipments; but where size is a consideration, it carries all before it, as masts of 110 feet in length, and 32 inches diameter, are by no means exceptional. The curious on this point will be pleased to inspect the celebrated flag pole in the royal gardens of Kew, which is an example, 159 feet in length and of proportionate thickness.

The Kaurie pine ranks with the Oregon pine in being a monarch of the forest. This is otherwise known as the Australian pine, or Norfolk Island pine. Its quality for masts is everything that can be desired; and although its cost is very great, owing to the excessive sea carriage, it is by no means a rarity in this country. Some years ago, the governor of New Zealand sent a gigantic mast to the English Admiralty, and a friend of ours, who was a passenger home with this tree, says it was lashed to the masts and bowsprit, and projected over the head and stern of the ship 30 feet. It was found to be highly suitable for masts and spars, and a commission of experts from the dock yards was afterward sent out to examine and report upon the Australian forests. A tree of this class was felled on a farm near the Maharangi River, intended for the 1851 Exhibition in London; but the time allowed for transport being too short, the project was abandoned, and the tree was left upon the ground. The length of the pole up to the branches of the bushy head was 100 feet, and its diameter at the butt was 10 feet. Laslett mentions a still larger tree, which measured 80 feet to the branches and 24 feet in diameter. About fifteen years ago a parcel of 60 logs arrived in Liverpool on consignment to Mr. Edward Chaloner; we were told they averaged 90 feet in length, and squared up to 3 feet, and that they were perfectly clear and sound.

AFGHANISTAN—A COMPANY OF THE ROYAL ARTILLERY CROSSING THE DARANTA FORD, CABUL RIVER.

It would appear with the mast trade, as with many other industries, there is a constant thirst for change; the latest fashion is the construction of the lower masts and the principal spars of wrought iron, a system that places, for once in the career of English shipbuilding, the growth of our masts in our own hands. The objection taken is that they are heavy, and in case of disaster they cannot be felled and thrown overboard; but this appears to have little consideration, for the manufacture of tubular iron masts is becoming very general, and to-day there are few of our first-class ships but what are so fitted in their rigging.

[Continued from SUPPLEMENT No. 233, page 3718.]

FOREST TREES OF NORTH AMERICA.

By CHARLES S. SARGENT, Arnold Professor of Arboriculture in Harvard College, Special Agent Tenth Census.

251. *Betula papyracea*, Ait. (Canoe Birch. White Birch. Paper Birch.) Latitude 65° N. (Richardson), south through British America and the Northern States to the mountains of Pennsylvania; west to Minnesota, Eastern Nebraska, and Dakota?; most common at the North. Wood white, compact, moderately hard, furnishing an excellent fuel; extensively employed in the manufacture of spools, shoe-lasts, pegs, etc., and now largely exported. A large tree, as far north as Hudson's Bay, and extending to a higher latitude than any deciduous tree of the Atlantic forests; the very tough, durable bark, is easily separated into thin layers impervious to water, and is largely used in the construction of canoes, tents, etc.

252. *Alnus incana*, Willd. (Speckled Alder. Hoary Alder. Black Alder.) Newfoundland to the Saskatchewan, and south to Northern New England, Wisconsin, Minnesota, and Nebraska; and in Europe. Wood hard and heavy; furnishing fuel preferred and largely employed in Northern New England for the final baking of bricks. A shrub, or sometimes a small tree; along streams and in swampy ground.

Var. virescens, Watson (Bot. Cal. ii. 81, ined.) extends from Oregon east to the Rocky Mountains, and south to the southern Sierra Nevada and New Mexico.

253. *Alnus maritima*, Muhl. (Sea-side Alder.) Delaware and Eastern Maryland; and in Japan? A small tree, sometimes 20 feet in height; along streams.

254. *Alnus oblongifolia*, Torr. Banks of the Mimbres River, and near Santa Barbara, New Mexico; Arizona; in the Cayumaca Mountains, San Diego County, and in the San Bernardino Mountains, California; also in Northern Mexico. A tree sometimes 80 feet in height, with a trunk 2 or 3 feet in diameter.

255. *Alnus Rhombifolia*, Nutt. From Oregon to Southern California; at San Felipe, California (Palmer), known as White Alder. "The common California Alder, 20 to 30 feet in height, and 2 to 3 in diameter, according to Bolander; 30 to 50 feet in height (Peckham); bark light ash gray."—Watson, Bot. Cal. ii. 80, ined.

256. *Alnus rubra*, Bongard. Sitka, south to Santa Barbara, California; common in the neighborhood of San Francisco. A tree 30 to 40 feet in height.

SALICACEÆ.

257. *Salix cordata*, Muhl. Great Slave Lake, Saskatchewan, and Lake Winnipeg; south through the New England States to the District of Columbia. A small tree, rarely 20 feet in height; along streams and in wet ground; running into many forms of which the best marked are:

Var. rigida, Gray (*S. rigida*, Muhl. *S. Torreyana*, Barratt).

Var. angustata, Anders. (*S. angustata*, Pursh).

258. *Salix lævigata*, Bebb. California, Sierra County, and from the valley of the Sacramento River to San Diego. "An erect pyramidal tree, 15 to 50 feet high, growing in bottom lands near streams; trunk straight, a foot or two in diameter, with fissured dark brown bark."—C. L. Anderson, in Bot. Cal. ii. 84, ined.

259. *Salix lasiandra*, Benth. *S. Hoffmanniana*, Hook. and Arn. *S. speciosa*, Nutt. *S. arguta*, var. *lasiandra*, Anders. British Columbia, and south to the valley of the Sacramento River, California. "A tree 20 to 60 feet high, growing along streams."—Bebb, in Bot. Cal. ii. 84, ined.

Var. lancifolia, Bebb. (*S. lancifolia*, Anders. *S. lucida*, var. *macrophylla*, Anders.). With the species. *Var. Fendleriana*, Bebb. (*S. pentandra*, var. *caudata*, Nutt. *S. Fendleriana*, Anders. *S. arguta*, Anders.) Colorado, New Mexico, and in the Sierra Nevada of Central California.

260. *Salix lucida*, Muhl. (Shining Willow.) Mackenzie River, in latitude 65° north, through British America and the New England States, south to Chester County, Pennsylvania. A shrub or small tree, rarely exceeding 20 to 25 feet in height; along streams.

261. *Salix nigra*, Marsh. *S. ambigua*, Pursh. *S. Houstoniana*, Pursh. *S. Caroliniana*, Michx. *S. falcata*, Pursh. (*S. Purshiana*, Spr. *S. nigra*, var. *falcata*, Gray.) Canada (rare) and Northern Vermont; south to Florida, and west to the valley of the Sacramento River, Clear Lake, and Fort Mohave, California; most common between the Alleghany and Rocky Mountains. A small tree, 30 to 40 feet in height, with a trunk sometimes 10 to 18 inches in diameter.

262. *Populus angustifolia*, James. *P. Canadensis*, var. *angustifolia*, Wesmael in DC. Prodr., xvi.² 329. *P. balsamifera*, var. *angustifolia*, Watson, Bot. King Rep. v. 327. In the Rocky Mountains of Colorado and New Mexico; Central Arizona; in the Shoshone Mountains, Central Nevada, and northwestward to the valley of the Columbia River. Wood considered of little value. A medium-sized tree.

263. *Populus balsamifera*, L. (Balsam Poplar. Tacamahac. Balm of Gilead.) Mackenzie River and the Great Slave Lake; south through British America to Northern New England and Wisconsin. A large tree. Common in Arctic America, and furnishing, according to Dr. Richardson, the greater part of the drift timber on the shores of the Arctic sea.

Var. candicans, Gray (*P. candicans*, Ait. *P. nigra*, Catesb. *P. macrophylla*, Lindl. *P. Ontariensis*, Desf.). Arctic America to Northern New England, Wisconsin, and Kentucky; west to Colorado and Idaho. A large tree. Rare in a wild state, although very common in cultivation.

264. *Populus Fremontii*, Watson, Proc. Amer. Acad. x. 350. *P. monilifera*, Newberry, Pacific R. Rep. vi. 89; Watson, Bot. King Rep. vi. 327. Valley of the upper Sacramento River, California; eastward in Nevada and Southern Utah. A large tree.

Var. Wislizeni, Watson, in Am. Jour. Sci. (3 ser.), xv. 137. (*P. monilifera*, Torr. Bot. Mex. Bound, 204.) "The prevalent Cottonwood in the more southern districts ranging, from San Diego County, California (Jamul Valley, Palmer), and the Colorado Valley (Fort Yuma—Schott), to Southern Utah and the Rio Grande."—Watson, Bot. Cal. ii. 92, ined.

265. *Populus grandidentata*, Michx. Nova Scotia, New Brunswick, Canada, and through the Northern States; along the Alleghany Mountains to North Carolina, and west to Wisconsin and Iowa. Rare at the South; common at the North. Wood white, soft, very light; large quantities of the wood of this species have of late years been ground into pulp in Northern New England and Michigan, and used as a substitute for rags in the manufacture of paper. A medium-sized tree, sometimes 70 to 80 feet in height, with a trunk 20 to 30 inches in diameter.

266. *Populus heterophylla*, L. *P. argentea*, Michx. f. *P. heterophylla*, var. *argentea*, Wesmael in DC. Prodr. xvi.² 326. (Downy Poplar. Cotton Tree.) Western Massachusetts; ? Northport, Long Island, to the valley of the lower Ohio River; south to the Cape Fear River, North Carolina, and Southern Arkansas. Wood white, soft, probably of little value. A large tree, often 70 to 80 feet in height, with a trunk 3 to 4 feet in diameter; in swamps and along river bottoms. Rare.

267. *Populus monilifera*, Ait. *P. angulata*, Ait. *P. angulosa*, Michx. *P. Canadensis*, Desf. *P. Marylandica*, Bosc *P. lævigata*, Willd. *P. glandulosa*, Mœnch. (Cottonwood. Necklace Poplar. Carolina Poplar.) Western New England, west to the Rocky Mountains of Colorada and Idaho; south to Florida and Louisiana. Wood white, soft, of little value. A large tree, 80 to 100 feet in height, and with a trunk 4 to 8 feet in diameter; the common Cottonwood of the western plains, bordering all streams flowing east from the Rocky Mountains.

268. *Populus tremuloides*, Michx. (American Aspen. Quaking Asp.) Arctic America, south to the mountains of Pennsylvania, New Mexico, and the valley of the Sacramento River, California. Very common on all the mountain ranges from the Rocky Mountains, west and north, at 6,000 to 10,000 feet elevation, in moist slopes and bottoms. Not yet seen on the high peaks of the southern Alleghany Mountains, to which it might naturally extend. Wood white, soft, easily worked; esteemed and somewhat used in Utah for flooring and in turnery, and in Northern New England with that of *P. grandidentata* in the manufacture of paper. A small tree, sometimes 50 feet in height, with a trunk rarely exceeding 18 inches in diameter. The most widely distributed of North American trees.

269. *Populus trichocarpa*, Torr. and Gray. *P. Balsamifera*, var. γ Hook. Flor. Bor. Am. ii. 154. *P. Balsamifera*, var. (?) *Californica*, Watson, Am. Jour. Sci. (3 ser.) xv. 136. "San Diego, California, northward to British Columbia, and extending into Western Nevada. According to Douglas, it attains in Washington Territory a height of 60 to 100 feet, with a diameter of 2 to 6 feet. It is generally found scattered, or in open spaces along stream banks and in river bottoms at an altitude not exceeding 6,000 feet."—Watson, Bot. Cal. ii. 91, ined.

TAXACEÆ.

270. *Torreya Californica*, Torr. *T. Myristica*, Muir, Edinb. New Phil. Journal, x. 7, t. 3; Bot. Mag. t. 4780. (California Nutmeg.) California, from Mendocino County to Yuba and Mariposa Counties. Wood light-colored, close-grained, compact, heavy, odoriferous, probably valuable. A tree 50 to 75 feet in height, with a trunk 1 to 3 feet in diameter; when cut throwing up suckers very freely from the stump.

271. *Torreya taxifolia*, Arn. (Stinking Cedar.) Along the eastern bank of the Apalachicola River, Middle Florida. Wood exceedingly durable, odoriferous, especially when burned. A small or medium-sized tree, 20 to 40 feet in height, with a trunk 1 to 3 feet in diameter; like the last, throwing up suckers when cut from the stump; an exceedingly local species.

272. *Taxus brevifolia*, Nutt. *T. baccata*, Hook. Fl. Bor. Am. ii. 167, in part. *T. Boursieri*, Carriere. Rev. Hort. 1854, 228. *T. Lindleyana*, Muir, Edinb. New Phil. Journal, i. 294. British Columbia, and south to the Sierra Nevada of Central California. Wood reddish, hard, tough, elastic, very heavy, durable, susceptible of a brilliant polish. In Oregon a tree, 40 to 60 feet in height, with a trunk sometimes three feet in diameter; in California, rarely exceeding 20 to 30 feet in height.

273. *Taxus Floridana*, Nutt. Banks of the Apalachicola River, Middle Florida. A small tree, 10 to 20 feet in height; very local, and still imperfectly known.

Taxus baccata, L. var. *Canadensis*, Gray. *T. Canadensis*, Willd. A shrubby species; common in Canada and the Northeastern States, south to the mountains of Virginia.

CONIFERÆ.

274. *Juniperus Californica*, Carrière. *J. Andina*, Nutt.? *J. tetragona*, var. *osteosperma*, Torr. *J. Cervoanus*, Kellogg. *J. occidentalis*, Parl. in DC. Prodr. xvi.² 489, in part. California, in the coast ranges, from the valley of the Sacramento River, south to San Diego. Wood light-colored, slightly aromatic, close-grained, moderately heavy A shrub or small tree, sometimes 20 to 30 feet in height.

Var. Utahensis, Engelm. Trans. Acad. St. Louis, iii. 588. *J. occidentalis*, Watson, Bot. King Rep. v. 336, in part. On all the ranges of Central Nevada, south to Arizona and Southern Utah; very common at 5,000 to 8,000 feet elevation. Wood resembling that of the species, and in Central Nevada furnishing the common and cheapest fuel. A shrub or low bushy tree, 10 to 20 feet in height, with a trunk rarely exceeding two feet in diameter.

(To be continued.)

THE JAPANESE VARNISH TREE.

MR. F. B. PATTERSON gives in the *Coach Painter* the following interesting account of the tree from which lacquer is made:

The varnish tree, called by the Japanese *Urusi* and the Chinese *Tsi-chou*, grows extensively throughout both China and Japan. It seems to be a natural product, as it is found growing wild on the mountains, but is also cultivated largely on the plains. The manner of growing it and the method of getting the juice are not unlike those resorted to in the case of our long-leaved pine in the South. Tracts of it are kept under cultivation and regularly tapped. Like our pine, it has its seasons, the spring yield being the most favorable. Parties go out in the early morning and make a "tapping" round. This is done by making a circular incision, under which they place a sort of bowl to catch the drippings. Some hours after they again make the rounds in the same order in which the trees were tapped, and collect the juice in a bamboo flask slung at the side. Great care has to be used in handling the fresh juice, as it is extremely poisonous; if it gets spattered into the face it causes an eruption, which manifests itself in blisters, known as varnish-boils, which produce an intolerable itching. This poisoning, too, is sometimes fatal. After the juice has been collected it is filtered through one of those delicate web-like Japanese or Chinese papers to strain out any impurities, and allowed to stand in the sun to evaporate what water may be in it. The fresh juice is of a milky color and about the consistency of mucilage, but it turns a dark color on exposure to the air. The Japanese and Chinese, however, add bone-black if they wish a black lacquer, or a little red orpiment if they desire a red lacquer, and by other means obtain effects in gold and other colors; they also seem to succeed in realizing the ideal of all varnish-makers in keeping the varnish very pale and transparent when they so desire. Why is not this tree, which is capable of such important and extensive use, imported and naturalized in this country? This is the question which naturally arises in every one's mind upon being made familiar with these facts. We will answer the question when we state that the tree has been transplanted to a considerable extent. Messrs. Veitch & Son, horticulturists and seedsmen, imported the varnish tree into England some years ago. There are to-day also specimens of the varnish tree growing in the grounds of the Department of Agriculture at Washington. But that either of these experiments have had any economic results or in any way influenced varnish-making, either in this country or England, we have so far been unable to learn.

M. ZININ, the well-known Russian chemist, recently died at St. Petersburg. One of his chief discoveries was the conversion of nitro into amido compounds. One of the first substances made in this way was aniline.

A CATALOGUE, containing brief notices of many important scientific papers heretofore published in the SUPPLEMENT, may be had gratis at this office.

THE

Scientific American Supplement.

PUBLISHED WEEKLY.

Terms of Subscription, $5 a Year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, $2.50, stitched in paper, or $3.50, bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents, and canvassers.

MUNN & CO., Publishers,
37 Park Row, New York, N. Y.

TABLE OF CONTENTS.

PAGE

I. ENGINEERING AND MECHANICS.—Wire Rope Cable Apparatus. 4 figures. Bullivant's wire-rope cable apparatus..... 3723
Distilling and Hoisting Machinery for Sea-going Vessels. By HAMILTON WELDON PENDRED. 24 figures. Details of the Gravelley system..... 3723
Wheat, and How it Should be Prepared. 8 figures. Showing the parts of a wheat kernel..... 3726
Useful Hints for Millers. Bolting cloth handkerchiefs.—Recipe for boiler incrustation.—Lubricators.—Belting Cement.—Flour insects.—Bent shafting.—Conveyor shafts..... 3727
Ring Spinning. 3 figures. Ring Spinning Implements..... 3727

II. TECHNOLOGY AND CHEMISTRY.—MM. Pelouse and Audouin's Gas Purifier. 3 figures..... 3719
Acetate of Soda Manufacture..... 3719
Azo and Naphthol Dyes. By G. AUERBACH..... 3720
Alizarine Carmine..... 3720
Character of Animal Fibers..... 3720
M. Zinin..... 3720

III. ELECTRICITY, LIGHT, ETC.—Prism with Wide Angled Apianates. 2 figures..... 3721
The Storage of Electricity. M. Gaston Plante's Secondary Pile.—Houston and Thomson's Apparatus.—M. d'Arsonval's Voltaic Condenser. 4 figures..... 3722

IV. MEDICINE, HYGIENE, ETC.—Dumontpallier's Refrigerative Cover for Fever Patients. 2 figures..... 3721
Chian Turpentine. The new cancer cure..... 3721

V. NATURAL HISTORY.—Chameleons. Continuation of Professor J. REAY GREENE'S paper from SUPPLEMENT, No. 233. A natural fly-catching machine.—Classification.—Color changes.—The Chameleon's tongue.—Eyes.—Characteristics.—Reproduction..... 3727
Snakes. Ruskin's lecture..... 3728
The Rat King. A curious habit. 1 illustration..... 3728
Elephant Battery Crossing the Cabul River. 1 large illustration. 3728
Spars. Ships' masts and their sources.—Quebec yellow pine.—Quebec red pine.—United States pitch pine.—Kaurie pine.—Oregon pine..... 3728
Forest Trees of North America. Continuation of Prof. SARGENT'S Catalogue. Alders.—Willows.—Poplars.—Cedars..... 3729
The Japanese Varnish Tree..... 3730

PATENTS.

In connection with the **Scientific American,** MESSRS. MUNN & CO. are Solicitors of American and Foreign Patents, have had 35 years' experience, and now have the largest establishment in the world. Patents are obtained on the best terms.

A special notice is made in the **Scientific American** of all Inventions patented through this Agency, with the name and residence of the Patentee. By the immense circulation thus given, public attention is directed to the merits of the new patent, and sales or introduction often easily effected.

Any person who has made a new discovery or invention can ascertain, free of charge, whether a patent can probably be obtained, by writing to MUNN & CO.

We also send free our Hand Book about the Patent Laws, Patents, Caveats, Trade Marks, their costs, and how procured, with hints for procuring advances on inventions. Address

MUNN & CO., 37 Park Row, New York.
Branch Office, cor. F and 7th Sts., Washington, D. C.

The Scientific American Supplement. Index for Vol. 9.

JANUARY—JUNE, 1880.

The * indicates that the Article is illustrated by Engravings.

A

Abscess of brain 3525
Absence of mind, also disease. 3715
Absorption plan, the 3444
Academy Nat. Science, Phila. 3381
Accumulator, hydraulic *3659
Acetate of soda manuf 3719
Acid, tannic in sumac 3541
Acid, gallic, test for 3696
Acid hydrochlo., detection 3483
Acid, salicylic, how made 3649
Acid, arsenic 3593
Acid cholic, oxidation product 3403
Acid, benzoic 3594
Acid phthalic 3594
Acid, formic, synthesis 3714
Acid vapors on vegetat'n, effect 3461
Acid hydrochloric in blasting. 3354
Acid salicylic and uses 3600
Acid rubin 3596
Acid salicylic in rheumatism. 3543
Acids, cement to resist 3443
Acids, fatty, and fats 3593
Actinometers *3490, *3521
Adulteration of jellies, new.. *3695
Africa, Central *3322
African cable 3341
African hippopotamus hunting *3509
Afghanistan, elephant in.... *3458
Age of horse, to tell 3462
Agricultural items 3700
Air-pump, simple mercurial.. *3569
Air, compressed, refrig. app. *3421
Air, water and 3593
Albert medal 3536
Albumen, blood 3714
Albuminate of iron 3573
Albuminuria 3631
Albuminuria, healthy kidneys 3400
Alcohol, proportion of water.. 3604
Alcohol, detect'n in beer, etc. 3378
Alcohol in fruit juices 3696
Ales and beers as medicine 3619
Algeria and Spain, good'ic con.. *3535
Alimentation, forced 3531
Alkaline, developments 38.8
Alkaloids, artificial 3714
Alloys, etiquation 3617
Alloys, copper-tin, conductiv.. 3341
Alloys, gallium and aluminum 3304
Almond oil, volatile 3667
Alum 3523
Alumina salts 3407
Aluminum and gallium, alloys 3304
Aluminum, electro-mot. force. 3602
Aluminum sulphate 3509, 3523
Amateurs, gelatin emuls. for.. 3604
Amber, concerning 3596
America, an Englishman on.... 3480
America, diseased pork from.. 3465
America, North, forest trees 3622, 3637, 3654, 3670, 3686, 3702
America, wheat handling in.... 3663
American grain elevator, Lou.. *3496
American apples in Europe.... 3.76
American cotton mill *3518
American cotton mills 3354
American dinosaurs 3633
Ammonia from the air 3474
Ammonium sulph. metals, sep. 3359
Ammonium chloride 3410
Anæsthetic, new 3475
Analyses, iron, filtrat'n carbon *3443
Analyses, sugars of commerce. 3536
Analysis, chem., sep. of precip. *3441
Analysis, organisms con. nitro. 3440
Analysis, elect. current in.... 3712
Analysis of commercial potash 3375
Anatomy, cats for study of.... 3699
Aniline for gelatin paper 3605
Aniline, methyl, violets 3667
Aniline inks, formulæ 3667
Animal fibers, character of.... 3720
Animal, to control sex of..... 3306
Animals injur. to sugar cane.. 3700
Annealing in boiling water 3705
Annealing steel 35.4, 3529
Ants, to destroy 3701
Ants, white *3557
Antiquities, Egyptian *3546
Antiquity of glass 3398
Antiseptic dressing 3444
Aphis, to destroy 3701
Apparatus to test milk *3630
Apparatus for extract., Julhe's *3556
Apparatus, aberrat'n of light . *3658
Apparatus to consume smoke. *3452
Apparatus, automatic disinfec. *3620
Apparatus for hot pressing.... *3560
Apparatus, artificial sandstone 3337
Apples, American, in Europe.. 3476
Apples, preservation of 3348
Apples, preserving 3348
Applied science exhibit, Paris 3499
Archæological discov. Phœnicia 3446
Arches and tunnels, beton.... *3607
Architecture, bird *3637
Architecture, suggestions in.. 3601
Arctic exped., Swedish. *3673, 3692
Arctic exploration, Swedish.. *3672
Argol black 3629
Arizona, gum lac from 3694
Arizona, steam hip *3336
Arizona R. R., lands along.... 3362
Armor, cast iron, chilled *3418
Army, German, canteen for.... 3469
Arsenic acid 3593
Arsenic, determination of..... 3618
Art and nature *3589
Art, decorative, suggestions in *3392, *3406, *3561, *3681
Art, ecclesiastical, exhibit'n .. *3597
Art, industrial, masterpiece... 3540
Artesian wells and the Sahara. 3434
Artists' homes *3680, *3718
Artificial diamonds 3439, 3140
Artificial sandstone apparatus. 3337
Ash of eucalyptus 3661
Asphaltum 3441
Asphaltum, melting of 3341
Asphyxia, speedy method..... *3428
Asthma and hay fever 3525
Astronomical Society, Royal.. 3538
Athabasca wheat fields 37.1
Atmosphere, pressure, distrib. 3662
Attraction, influence of shape. 3653
Aurora, wonders of 3361
Australia, rapid steam transit.. 3497
Australian internat'l exhibit n. *3480
Australians, narcotic of 6634
Austrian R. R. engine *3659
Autographic processes 3579
Automatic mental action 3705
Azo and naphtha dyes 3720
Aztec ruins in Mexico *3006

B

Balance, hydrostatic *3508
Balancing pulleys *3516
Baldness, pilocarpine in 3685
Balmain's luminous paint 3647
Bapistery, design for *3501
Barff process for iron *3598
Barks, new 3622
Barometer, Draper's mercurial *3319
Barometric pressure 3618
Basalck mine *3407
Bath, the Turkish 3509
Battery, chloride lime 3341, 3358
Battery, nickel *3341
Bavaria, timber shoot in *3336
Belgian permanent exhib 3466
Benzine, newer colors from.... 3697
Benzines, coal and petroleum 3697
Benzoic acid 3524
Beer, lager, how to make 3457
Beer, milk 3477
Beer, sulph. hydrogen in 3587
Beers and ales as medicines.... 3819
Beeties, way to destroy 3701
Beets in cider making 3621
Berlin fisheries exhibit 3708
Beton tunnels and arches *3607
Biology and microscopy 3390
Bird architecture *3637
Birds, eccentricities 3549
Birds, hum'g, fertilize flowers 3566
Blacks for dyeing 3622
Blasting, holes for by hy. acid 3354
Bleaching jute yarn 3514
Bleaching textiles 3714
Blendes, Amer., gallium in 3694
Blood albumen 3714
Blood, circulation of *3573
Blowing app. for laboratories. *3707
Blue, diphenylamine 3697
Boat, life, novel 3529
Boat, pleasure, double *3574
Boat, torpedo, Garrett *3164
Boats, double *3694
Boats, ice, speed of *3402
Bog butter 3606
Bog land, reclamation 3525
Bogie system locomotives *3415
Boiler protector, zinc as 3559
Boiler, steam, central feed *3416
Boilers, steam, gas-fired *3481
Bolette's condenser *3708
Boot cotton mills *3513
Borax 3410
Borings, inclination of *3416
Boston Pacific R. R. 3560
Boston, scavenging at 3620
Bot-fly, horse *3578
Bötger's test for sugar 3596
Bouquetin, the *3393
Brain, abscess of 3725
Brain, motor functions of..... *3545
Brake, electric railway *3515
Bread making, chemistry of.... 3536
Breakwater, Tees *3405
Breeding trout 3541
Brick, fire, new *3450
Bridge over Firth of Forth 3405
Bridge, Firth, design *3640
Bridge, Severn 3559
Bridge, Tay, disaster *3421
Bridge, Tay railway *3399
Bridge, the Tay *3434
Bridges, double-bow girder.... *3698
Bridges, improvements in..... 3353
Bridges, iron, new systems.... *3704
Brighton, St. Mary's church.. *3467
Bright's disease, unrec'nized. 3689
Bromide of ethyl 3475
Bromine 3593
Bromine and iodine, separat'n *3629
Brown's tramway railways *3528
Brussel's permanent exhib.... *3598
Bucket, Old Oaken (version).. 3512
Bug, the chinch 3477
Building materials, porosity .. *3561
Building, ship, progress 3325
Burmah, oil wells of 3547
Burner, electric, new 3469
Burns and scalds 3573
Butter, bog 3696
Butyrellite 3696

C

Cable, African 3341
Cable apparatus, wire rope.... *3723
Cable, Marseilles, Algiers.... *3488
Calais lace manufacture..3566, 3596
Calcium acid phosphate 3523
Calcium chloride 3410
Calendering rolls, Vita's *3537
California raisins 3701
Calorimeter *3470
Caloric engine, solar *3471
Calorific, Pictet's calorific..... 3442
Camera for microscope, cheap. *3469
Canal, dry, for ships *3464
Canal projects, interoceanic.. 3369
Canal or railway? 3514
Canals, Suez 3675
Canary Islands 3696
Candles, Roman *3528
Canned meats 3480
Canned goods, exportation..... *3327
Canoe, light paddling *3484
Canoes, canras, construction of. *3438
Canteens for German army..... 3369
Caps from Ste. Chapelle *3651
Capstan, hydraulic *3451
Carbon, action of watery vapor. 3574
Carbon disulphide 3593
Carbon, filtration of *3443
Carbon in iron, estimation..... *3498
Carbon points, temperature.... 3469
Carbon, quantity in steel 3518
Carmeloine 3067
Carmine, alizarine 3720
Carob, culture in Cyprus 38.8
Cartometer *3572
Cashmeres and silks, cleaning. 3475
Casket in oak, Berlin *3696
Cast iron armor, chilled *3418
Castor oil, substitute 3691
Catamaran steamer *3574
Catarrh cure 3444
Caigut carrying machine 3574
Cathedral, Cork, pavement.... *3562
Cathedral, Lincoln, Misereres. *3681
Cathedral, St. Paul's 3598
Cathedral, Lichfield *3486
Cats for study of anatomy..... 3699
Cattle in Colorado 3695
Cauras, canoes, construction of. *3438
Celestial objects seen by eye.. 3411
Cellulose 3541
Celluloid, or parkesine 3617
Cement for glass, etc 3393
Cement, hydraulic 3393
Cement, Portland 3695
Cement to resist acids 3443
Cement, transparent 3536
Cements, rosins and fats in, 3603, 3604
Centrifugal milk tester *3491
Centrifugal pumps, new uses.. 3353
Cerro de Pasco, Peru 3362
Ceylon, ramble through 3369
Chameleons ..... *.715, 3727
Charleston whale *3717
Checks, forged 3615
Chimpanzee and gorilla *3403
China, new vegetable from.... 3510
China, future of 3540
China, steel making in 3695
Chinch bug 3477
Chimneys, hot water, French.. *3382
Chipmunk and its nest 3462
Chemical affinity 3618
Chemical analysis *3441
Chemical progress, recent.... 3648
Chemical Society, London..... 3650
Chemicals, organic 3524
Chemistry, analytical 3712
Chemistry, industrial, progress, 3409, 3503, 3698
Chemistry of light 3533
Chemistry of bread making.... 3536
Chloral inebriety 3374
Chloric acid 3403
Chloride of lime battery 3341
Chloride, platino-potassic 3442
Chlorine, decomposition of.... 3341
Chlorine, researches on 3650
Chlorine in organic bodies.... 3367
Chlorophyl, function of. 3350, 3581
Cholecystolomy, a case of 3459
Chromate black 3629
Chrysalis, does cocoon protect? *3636
Church, St. Mary's, Brighton. *3467
Cicindelidæ, adaptation 3586
Cider, beets in, manufacture of. 3621
Cigarettes, machine made..... 3708
Circulation of blood *3573
Circuits in dynamo machines.. 3656
Cistern, water, position 2487
Cities, drainage and sewerage. 3602
Clamond's thermo elect. pile.. *3538
Cleaning cashmeres and silks. 3475
Cleopatra's needles *3543
Clerk-Maxwell, Prof 3342
Climate, cure in nerv. diseases. 3394
Clock, japis lazuli *3541
Cloth, woolen, soaking 3604
Coal, wastes of 3477
Coal, sulphur in 3698
Coal gas, combustion 3650
Coal gas, heating power 3497
Coal and gas, comparative val. 34.7
Coal and iron mines of Va..... 3697
Cobalt, malleable 3564
Cobalt and nickel 3535
Cobalt and nickel, separation. 3360
Cocoon, and effect of cold on. *3636
Cod liver oil, substitute 3691
Coil, induction, large *3647
Colds, cure for 3631
Color, effects of on distance.. 3502
Colorado, silicic mine *3407
Colorado, cattle in 3021
Colorado glacier 3513
Colored rings on mercury 3440
Coloring of cucumis 3604
Coloring matter, new violet.... 3474
Coloring matters, new 3694
Coloring matter of sea weeds.. 3629
Coloring matters, new 3439
Coloring matter from benzene. 3697
College, Yale, paleontology ... 3379
Collieries, Newent *3483
Collodion electric machine 3662
Collodion transfers, stripping. 3499
Collography 3579
Colors, photographing 3439
Combat, naval, in Pacific 3368
Compass, variation in U. S.... 3627
Compound, new metallic 3530
Condenser, Bolette's, yarns.. *3708
Cones, pine, turpentine from. *3443
Constipation as a disease..... 3574
Conservatories, small *3564
Contest, reaping machine..... 3558
Copperas, falsification of..... 3475
Copper, coating iron w.th..... 3394
Copper, reflection from 3650
Copper-tin alloys 3341
Copper, wire diffusion 3535
Copying drawings, Pellet's... 3580
Copying process, letter 3595
Cork Cathedral mosaic work.. *3406
Cork Cathedral pavement..... *3562
Corrosion of iron 3628
Cosmogony of La Place 3350
Cotton and wool, mixed 3604
Cotton and silk, mixed 3629
Cotton crop for 1879 3348
Cotton mill, American *3513
Cotton mills, American 3354
Coursing *3363
Cover, refrigerative *3721
Craig's weighing apparatus.... *3327
Cranberries, to raise 3540
Crighton's insulator 3533
Crop of cotton for 1879 3348
Croup and diphtheria 3346
Croydon sewerage works 3387
Crucible furnace, oscillating.. *3333
Cruiser, a Russian 3691
Crystals for polariscope 3397
Crystillization, specif. vol. of. 3440
Cultivation, olive, in Cyprus.. 3638
Culture of onions 3606
Cupelling of gold and silver... 3553
Cupric test pellets 3595
Curare in hydrophobia 3695
Cure for colds 3631
Cure for catarrh 3444
Cures by electricity 3444
Curtains, stage, metal 3369
Cut worms, to destroy 3701
Cylinder of Cyrus the Great 3349
Cylindroid, the *3402
Cyprus, culture olive, etc., in. 3638
Cyrus the Great, cylinder of.. 3349

D

Dam, Davis Island, derrick.... 3376
Dams and weirs in India 3505
Darke's indicator *3694
Davis Island dam, derrick..... 3376
Decay of the emotions 3573
Decorative art, suggestions in. *3392, *3406
De Meriten's electric machine *3560
Dentistry in the U. S 3699
Diaphosphorization of iron 3393
Deposits of ore, origin, etc.... 3554
Deprez electric motor *3374
Deprez magneto-elect. mach.... 3551
Derrick of Davis Island dam.. 3376
Design for conservatory *3564
Detection of alcohol in beer.... 3578
Developer, Eder's 3618
Developer, iron lactate 3604
Development, alkaline 3618
Development, gelatine plates.. 3665
Diameters of Mars 3652
Diamond, artificial formation. 3573
Diamond, artificial production. 3411
Diamond, origin, etc., of..... 3473
Diamonds, artificial 3439, 3440, 3678
Diamonds, manufacture of..... 3382
Diarrhea, cure by ice water.... 3619
Diastase and ptyalin 3444
Digestion, effects alum. salts. 3407
Dinosaurs, American 3593
Diphenylamine blue 3697
Diphtheria and croup, differ.. 3346
Diphtheria and milk 3344
Discoveries in Phœnicia 3446
Disease, singular 3622
Disease, thoughts on treatm't. 3443
Diseases, nervous, climate cure 3594
Diseases, skin, treatment 3344
Disinfectant, egasse 3585
Disinfectants 3459
Disinfecting app, automatic.. *3620
Dissociation metalloid el'm'ts. 3645
Distance, effect of color on.... 3502
Distillation, fractional 3375
Distillation of mercury *3443
Distilling machinery *3723
Diving helmet, Fleuss' 3627
Diving system, new *3653
Domestic poisons 3480
Dominica, volcanic eruption .. 3359
Double boats *3694
Double-bow girder bridges.... *3528
Douche, hot water vag nal 3459
Drainage of cities 3602
Drawings, copying, Pelle's.... 3580
Dredger, tug, and fire engine.. *3326
Driver, engine, death of oldest 3704
Drop hammer, improved *3415
Drumheads, artificial, for car. 3460
Dry plates, rapid 3644
Dyeing recipes 3084
Dyeing, blocks for 3620
Dyes, azo and naphtha 3720
Dynamo-magnet., mach. circ.. 3656
Dynamo-electric, mach. cir.... 3656
Dynamo-electric mach. *3358, *3562, *3567, *3580
Dynamo-elect. ma., Gramme.. *3711
Dynamometer, Farcot's *3418
Dyspepsia, washing stomach.. 3498

E

Ear, the 3460
Earth, great age of 3478
Earth, role in elect. transm.... 3551
Earthquakes 3704
Eccentricities of birds 3349
Eclipse of sun, recent 3521
Eclipse, solar, 1880 3579
Eclipses, solar, total 3620
Edge's grooveless tramway.... *3495
Edison electric pen 3579
Education of women, hygiene.. 3482
Education, industrial *3603
Eel, enormous 3349
Effects of a fixed idea 3461
Egasse disinfectant 3584
Eggs of oyster, fertilization.. 3350
Egyptian antiquities *3546
Electric burner, new 3469
Electric current in chemistry.. 3712
Electric gaslighter *3389
Electric gas-pressure regulator *3405
Electric lamp, Stewart's *3681
Electric lamp, Werdermann.... *3453
Electric light 3566
Electric light, Edison's 3710
Electric light, King's 3616
Electric light on vegetation.... 3644
Electric lighting in London.... 3581
Electric lighting, Lontin's.... *3329
Electric machine, coliodion.... 3684
Electric machine, DeMeritens *31.0
Electric machines *3656
Electric motor, Deprez *3572
Electric pen, Edison's 3579
Electric railway 3681
Electric railway brake *3515
Electric spark, glass pierced.. *3373
Electric spark, spectrum..... 3469
Electrical experiments 3662
Electrical storage system..... *3436
Electrical transmission *3551
Electrical telemeter *3647
Electricity and gas in Paris... 3519
Electricity in wool 3616
Electricity, cures by 3444
Electricity, disrup. discharge. 3682
Electricity, nature of *3519
Electricity, seeing by 3680
Electricity, storage of *3722
Electrolysis, case of 3525
Electrotyping, non-cond. mat. 3574
Electro-chemical printing 3579
Electro-dynamic transmission 3406
Electro-motive aluminum 3502
Electro-motive force, chem.... 3618
Elephant in Afghanistan..... *3548
Elephants crossing the Cabul. *3729
Elevator, American, London.. *3496
Elevator, grain, Reunis's..... *3677
Elimination of alloys 3617
Emotions, decay of 3573
Emulsion, gelatine 3360
Emulsion, gelatine, amateurs' 3604
Emulsion, gelatine, glycerine 3404
Emulsion, gelatine, keep'g.... 3565
Emulsion, gelatine process.... 3693
Engine, rail railway *3058
Energy, sun's radiant *3470
Engine driver, death of oldest 3704
Engine, fire, dredger, and tug *3326
Engine, gas, Turner's *3466
Engine, R. R., Austrian..... *3659
Engine, solar caloric *3471
Engine, steam, for mills 3706
Engine, vertical, for rail mill. *3689
Engineering, hydraulic..... *3326
Engines of s. s. Macdonnell .. *3705
Engines, compound, small *3705
Engines, marine, powerful..... 3640
Engines, pumping, newest..... *3340
Engines, pumping, powerful.. *3369
Engines, traction, military.... *3639
England, William *3665
Englishman, an, in America.. 3480
Ergot, liquid extract 3374
Etching on glass 3615
Ether, injection of in sciatica. 3460
Ethyl bromide 3475
Eucalyptus, ash of 3650
Euphorbium gum 3506, 3604
Evolution, geographical 3323
Evolution, man and *3429
Exhibition, Appl'd Sct., Paris, 3329, *3387, 3407, 3511
Exhib'tion, art, ecclesiast.... *3597
Exhibition, Belgian 3466
Exhibition, Brussels perman't *3298
Exhibition, fisheries intern'l. *3708
Exhibition, inter'l, Australian *3480
Exhibition, Melbourne Inter'l *3511
Exhibition, millers' interna'l.. 3436
Expansion, liquids and solids 3560
Expansion, linear *3079, 3691
Expedition, Swedish, N.east.. 3361
Experiment in induction *3261
Experiment, voltaic are *3616
Experiments, phoneidoscopic. *3490
Exportation, canned goods..... 3680
Extirpation of the spleen..... 3578
Extract of ergot, liquid 3374
Extraction apparatus, Julhe's *3586
Eye as automat. photometer.. 3682
Eye-pieces, microscopic 3656
Eye-pieces, microsc. imp'd.... *3658
Eye-pieces, powers of *3564
Eye, steel remov'd by magnets 3699
Eye, the naked, celestial obj's 3411

F

Falsification of copperas 3475
Farcot's bal. dynamometer.... *3418
Farming in Minnesota 3699
Farming, rose 3381
Fast speed vessels 3417
Fats and fatty acids 3593
Fats & rosin in cements, 3603, 3604
Fats and soaps, separation 3439
Fermentation, baromet. press. 3618
Fermentation, house'd relat.... 3411
Ferry st'r, Loftus Perkins.... *3447
Fertilizat'n flow's by Hummers 3568
Fertilization of oyster eggs.... 3350
Fever, yellow 3699
Fevers, malarial, soda sulp. in 3459
Filbois, endless chain R.R. at. 3550
Filter, a negative *3457
Filters, improved *3425, *3580
Filters, water, utility of 3352
Filtration of carb. in iron anal *3443
Finder, new range *3570
Fire brick, note on 3405
Fire engine, dredger, and tug. *3326
Fire, silver oxide 3360
Fire, smouldling, and ignition.. 3614
Firth Bridge, design *3640
Fisheries of north America.... 3708
Fisheries of Isle of Man 3652
Fisheries, pearl, Persian 3364
Fixed and movable weirs 3406
Flax, N. Zealand, in Orkney.. 3510
Flint or crystal glass 3694
Florida orange culture 3021
Flowers, fertil'd by Hummers 3568
Fluidity and galvan. conduc'ty 3574
Fluids, vibrating, in fluids 3636
Fly-paper, non-poisonous 3341
Food, thrift in relation to.... 3650
Force, elec.-motive of alum'm 3503
Forest trees of North America, 3622, 3637, 3654, 3670, 3686, 3702, 3730
Forest trees of the U. S 3718
Forged checks 3615
Formic acid, synthesis 3714
Fossil lovers 3586
Fowlis, alain 3396
Foundations, pneumatic *3406
Fracture of cast iron 3561
Fracture of radius, treatment. *3696
Frame, spinning *3404
France, poetry in 3638
Frith of Forth Bridge 3405
Fruit crops of Kentucky 3509
Fruit juices, alcohols in..... 3586
Fuel, the, of future 3437
Functions of leaves, physicol.. 3494
Furnace for mak gas, Farcot's *3696
Furnace, boiler, to prev. smoke 3584
Furnace, oscillating crucible.. *3333
Furnace, smoke-consu g, test.. 3704
Furnace, the Fisher 3584
Furnace, the Murphy 3395
Furnace, the Price 3584
Furnace, Walker, twin 3584
Furnaces, glass 3696
Future of China 3540

G

Gallia (S. S) pumping engines. *3309
Gallic acid, test for 3696
Gallium and albuminum alloys 3594
Gallium in American blendes.. 3694
Galvani, statue of *3585
Galvanic conductivity & fluidity 3574
Garbage, disposal, N. Orleans. 3622
Garden ladder, portable *3497
Gardening, window 3664
Garrett topedo boat *3464
Gas & coal, comparative values 3497
Gas and electricity in Paris... 3519
Gas and gas making 3713
Gas burning, science of 3567
Gas, coal, combustion 3650
Gas, coal, heating power 3497
Gas distillation, furnace *3696
Gas engine, Turner's *3466
Gas-fired steam boilers *3481
Gas-light, photographing by... 3593
Gas lighting, science of *3491
Gas-pressure regulators, elec.. *3405
Gas purifier *3719
Gas stoves 3694
Gas, pumping into mains *3677
Gases, injury to vegetation 3404
Gases, solub'y of solids in 3361, 3585
Gaslighter, electric *3389
Gastric juices, alumina on.... 3407
Gauge, rain and snow *3321
Gauge, wind *3320
Geissler's tubes, illuminat'n by 3343
Gelatine emulsion 3360
Gelatine emulsion for amateurs 3604
Gelatine emulsion, keeping.... 3565
Gelatine emuls'n with glycerine 3404
Gelatine filter *3407
Gelatine negatives, intensif'ng 3392
Gelatine plates, alkaline devel. 3628
Gelatine plates preparing..... 3604
Geodesic con. Algeria & Spain *3695
Geographical evolution 3323
Geology, synthetic study *3653
Germ, malarial, new 3374
German reclamation bog land. 3525
German silver, manganese 3345
Giffard injector, experi. with.. *3368
Gilding metal surfaces 3531
Girder bridges, double-bow... *3698
Glacier, a model 3694
Glass, annealing 3698
Glass, antiquity of 3398
Glacier, Colorado 3513
Glass, etching on 3615
Glass, flint or crystal 3534
Glass furnaces 3694
Glass, manufacture of 3696
Glass, optical 3699
Glass ornam. by photography. 3564
Glass, painting on 3498
Glass, properties of, etc..... *3373
Glass, silver., Leclerc's method 3564
Glass work, decoration 3699
Glass working processes 3699
Gold and silver, cupelling..... 3553
Gold, red and blue light from. 3448
Gold, separation by zinc 3650
Gorilla and chimpanzee *3402
Grafting, skin 3426
Grain elevat'r, Amer., London *3496
Grain reservoirs improved.... 3677
Gramme's dynamo-elec. mach *3711
Gravity, specific, of liquids 3698
Grav., spec., of liquids, to det. *3443
Green Mountains, age of 3693
Grooveless tramway *3495
Gum euphorbium 3506, 3604
Gum-lac from Arizona 3694
Gums, new solvent for 3502
Gun, new 13-pounder *3401
Gun, 100-ton, Italian *3699
Gun, "Thunderer," experim'ts *3431, 3433
Gun-barrels, to clean 3699
Guns of the future 3699
Guns, 100-ton 3401
Gymnastics, mechanical *3397
Gyroscope, magneto-electric.. *3710

H

Habits, influence of 3264
Hæmostatic, new 3630
Halley, Edmund, life of 3570
Hammer, drop, improved *3402
Hand, education of *3696
Hardening steel 3518, 3529
Hay-fever and asthma 3525
Health in wealth *3440
Heat conductivity of alloys 3341
Heat transmission 3367
Heating and lighting 3512
Heating power of coal gas 3497
Heilmann, Joshua 3235
Helmet, diving, Fleuss' 3627
Hemp, new use for 3670
Hens, laying, management.... 36.9
Heveenoid 3707
Himalayan mouffon *3334
Hints for the sick room 3509
Hippopotamus hunting *3509
Hoisting machinery *3723
Homes of artists *3699, *3706
Hop-resin 3536
Horse, hot-fly *3578
Horse, proportions of *3586
Horses' age, to tell 3462
Horses' legs, treatment 3574
Hot-air stoves, French *3581
Houlgrave's emulsion 3360
Huasear, capture of *3307
Hudson river tunnel *3610
Hundr d-ton guns 3401
Hunting, hippopotamus *3509
Hydraulic accumulator *3659
Hydraulic cement, white..... 3366
Hydraulic, capstan *3451
Hydraulic engineering *3696
Hydride of silicum, new 3442
Hydrochloric acid, detection.. 3093
Hydrochloric acid in blasting. 3354
Hydrogen, sulph'd, in beer.... 3087
Hydrophobia, curare in 3695
Hydrostatic balance *3508
Hygiene in education 3447
Hypophosphite soda, prepar'n 3349

I

Iceberg and s. s. Arizona..... *3325
Ice boats faster than wind 3402
Ice boats, maximum velocity .. 3402
Ice boats, speed of *3402
Ice boats, velocity 3402
Ice yachts, speed *3402
Idea, fixed, effects of 3461
Ignition, spontaneous 3614
Illumination, Geissler's 3343
Improvements in bridges 3353
Improvements in telescopes.. *3504
India, wiers and dams in 3505
Indian freighting pursuits..... 3696
Indicator, Darke's *3694
Indicator, Kenyon's *3706
Indicator, speed, Napier's..... 3477
Indigo, is it a poison 3694
Induction coil, large *3647
Induction, experiment in *3261
Industry, seats, at i arie exhib *3410
Industrial art, masterpiece.... 3541
Industrial, educat'n, new feat. *3699
Industrial chemis'y, prog. 3409, 3503
Inebriety, chloral 3374
Infection carried by catgut..... 3374
Insects, pneumo-enteritis 3621
Inhalation plan, the 3444
Injector, Giffard, experiment. 3368
Ink, non-corrosive writing..... 3398
Inks, aniline, formulæ 3667
Insects, how to fight 3701
Insecticides, two valuable..... 3470
Instrument, novel surgical.... *3444
Insulator, improved *3533

Intensifying negatives 3694
International exhibition 3496
International exhibit'n, Melb. *3511
Interoceanic canal projects 3699
Invisible, photography of 3429
Iodine 3693
Iodine and brom., separat'n. *3699
Iron and coal mines, Virginia. 3627
Iron albuminate 3573
Iron analysis, filterat'n carbon *3443
Iron, armor, chilled *3418
Iron, Barff process for *3393
Iron bridges, new systems *3704
Iron, carbon in, estimation *3498
Iron, cast, fracture 3560
Iron, cast, porosity 3437
Iron, coating with copper 3394
Iron, corrosion of 3698
Iron, dephosphorization 3393
Iron in the eye, removal 3699
Iron lactate developer 3694
Iron, pearl inlaying on 3565
Iron, prices of 3679
Iron protected by linseed oil, .. 3536
Iron, steel &c., for ships 3336
Iron, varnishes for 3603
Iron tenacity, influen. magnet. *3520
Iron sulphate 3593
Ironwork, notes on 3401
Islands, Canary 3606
Isle of Man fisheries 3692
Israelites and the Red Sea .. 3548
Italy, manna production in ... 3476
Italian 100-ton gun *3699

J.

Japanese, height and span of .. 3565
Japanese lady and Octopus ... 3550
Japanese navy 3694
Japanese varnish tree 3730
Jellies, new adulterant *3693
Juice, sugar, purification 3338
Julbe's extraction apparatus .. *3586
Jupiter, spots on *3552
Jupiter, red spot 3398
Jurassic dinosaurs 3633
Jute yarn, bleaching 3514

K.

Kansas mill 3676
Kensington, zoolog. museum .. *3703
Kensington, Mr. Stone's house *3708
Kenyon's indicator *3716
Ketchum, Morris 3491
Kilns, porcelain 3699
Kneading and mix'g machines. *3422

L.

Laboratory notes 3696
Laboratories, a blowing app.. *3707
Lac gum from Arizona 3684
Lace manufact. at Calais, 3566, 3586
Lactate of iron developer 3694
Ladder, garden, portable *3487
Lager beer, how to make 3457
Lake, large, dried up 3654
Lake Tulare, alkaline water .. 3712
Lakes of U. S., distribution .. 3691
Lamp, Werdermann elect., new *34.3
Lamp, electric, Stewart's *3681
Lands along Arizona R. R 3382
Landes, a sportsman of the ... *3480
Lanterns, photo *3619
La Place, cosmogony of 335
Launch, steam, small *3529
Law, railway, in N. Y 3671
Lead, clean gun barrels from .. 3699
Lead from tin 3618
Leaves, physical functions of .. 3494
Leaves, sumac, tannin of 3549
Leclerc's process silver'g glass. 3564
Lichfield cathedral *3486
Life, natural duration of 3305
Life boat, novel 3529
Light, Edison's electric 3710
Light, electric, on vegetation. 3644
Light, aberration, apparent .. *3658
Light, chemistry of 3533
Light, polarization of 3405
Light, solar vegetation on 3405
Light, red and blue, from gold. 3443
Light, new standard of 3583
Light, electric, King's 3616
Light, electric 3568
Light, recent wonders of 3582
Lighthouses, Norwegian 3417
Lighthouses, lights for 3672
Lighting, gas, regenerative ... *3491
Lightning conductors 3598
Lighting and heating 3612
Lightning, man struck by .. 3658
Lights for lighthouses 3372
Lignite 3397
Lime, chloride, battery 3459
Lime, reagent for 3588
Lime, action of on silica in ... 3340
Lime, chloride, battery 3341
Lime chloride pile, Niaudet's. *3490
Lincoln cathedral misereres .. *3681
Linseed oil as protection from. 3556
Lip salve 3444
Liquids, specific gravity 3699
Liquids and solids, expansion. 3592
Liquids, gravity of *3143
Litholapaxy 3442
Locomotive, passenger, fast .. *3675
Locomotives, Bogie system ... *3415
Locomotive, six coupled tank. *3415
Loftus Perkins, ferry steamer. *3447
London chemical society 3650
London physical society. 3627, 3682
London purple 3476
London, underground *3339
London, electric lighting in ... 3581
London, Am. grain elevator .. 3496
Longevity 3630
Longevity, Richardson on 3395
Longitude, determination 3688
Lontin system elec. lighting .. *3389
Louisiana moss industry 3480
Love, odor of 3573
Lovers, fossil 3589
Lubricants, rosin, fats in. 3603, 3604
Lucern 3348
Luminous paint 3630
Luminous paint, Balmain's 3647
Luminous tubes, new 3508, 3586

M

Machine, DeMeriten's electric. *3330
Machine, gas pumping *3678
Machine, wool cleaning *3422
Machines, kneading, mixing .. *3422
Machines, dynamo-electric, *3532, *3567, *3580
Machines for ornament paper. *3351
Machinery, Paris exhibition .. 3512
Magnesium sulphate 3410
Magnet circuits in elec. mach. *3358
Magnets, steel from eye 3699
Magneto-electro gyroscope ... *3710
Magneto-elect., Deprez *3551
Magnetic reactions *3455
Magnetism influence on iron .. *3529
Magnetic cir., dynamo mach .. 3656
Magnifying power, highest 3469
Maize, composition 3618
Malarial germ, new 3374
Malleable nickel and cobalt ... 3564
Man on Pacific coast 3664
Man and evolution *3429
Manna production in Italy ... 3476
Manchester lit. and philos. soc. 3446
Manganese German silver 3345
Manhattan, the steamship ... *3464
Manufacture of lace, Calais 3566
Manufacture of diamonds 3392
Marine engines, powerful 3640
Mars 3670
Mars, diameters of 3693
Mars, configuration of *3690
Mars, satellites of 3398
Mars, chart of *3690
Marseilles-A'giers cable *3488
Martyrs of science *3334
Mascaret, the *3328
Meats, canned 3480
Mechanical pursuits of Indians 3636
Mechanical gymnastics *3397
Medal, the Albert 3626
Medicines, administering 3715
Medical profession 3664
Melbourne Internat'l Exhibit. *3511
Memphis, serapeum of 3700
Mental action, automatic 3708
Mercurial air pump *3569
Mercury, bichloride 3594
Mercury, how to distill *3443
Murcury, colored rings on 3440
Mercury, influence of shock ... 3475
Mersey, tunnel under 3401
Metal, Spence's 3590
Metal surfaces, gilding 3551
Metal stage curtains 3369
Metals, heavy 3359
Metals, melting points of 3541
Metals, noble, action of ozone. 3587
Metals, specific heats of 3541
Metallic sulphides, new prop.. *3373
Metallic compound, new 3590
Metalloid elements, discov 3645
Metallurgy and mining 3511
Metallurgy, photo-electro 3500
Methyl-chloride, new applic 3604
Methylaniline violets 3697
Meteorograph 3444
Meteorological Obser, N. Y .. *3319
Mexico, Aztec ruins in *3606
Mhowa, edible flowers 3621
Microphone in muscular cont. *3546
Microphotographs, to take 3379
Microscope in investigation 3553
Microscope eye-pieces, imp'd .. *3658
Microscope, cheap camera for *3469
Microscopic eye pieces 3639
Microscopic objects, photogr.. 3404
Microscopic organisms 3461
Microscopy 3621
Microscopy, biology and 3380
Military traction engines *3619
Milk, medical uses of 3611
Milk and diphtheria 3344
Milk beer 3477
Milk-tester, centrifugal *3491
Mill, a Kansas 3676
Mill, rolling, engine *3692
Mill, rail, engine for *3692
Mill buildings, oscillation of .. 3451
Mill, cotton, American *3513
Millers' International Exhib .. 3436
Millers, useful items for 3727
Milling questions 3614
Milling, purposes of modern .. 3330
Milling in the West 3625
Mills, st. engines as motor for 3706
Mills, cotton, American 3334
Millstone spindles, pulleys, for 3396
Mind, absence, sign disease .. 3715
Mine, endless chain railway .. 3550
Mine, Bassick, Colorado *3407
Mineral lubricating oils 3587
Mineral water apparatus 3333
Mines, coal and iron, of Va ... 3627
Mines, sources of wealth 3613
Mining regions, Western 3499
Mining and metallurgy 3511
Minnesota, farming in 3580
Mirrors in photography 3780
Misereres, Lincoln Cathedral .. *3681
Mixing and kneading mach ... *3422
Mixed goods, silk and cotton .. 3629
Molecular change in wires 3655
Monument, Washington 3609
Moon, supposed changes in ... 3709
Moon not a dead star 3552
Morin, General A. J *3626
Morse telegraph, history of 3516
Mortar, action of lime on silica 3340
Mosaic pavement *3562
Mosaic work, Cork Cathedral .. *3406
Moscow, new temple at 3453
Moss industry in Louisiana 3480
Moths entrapped by plant 3382
Motion, vibrating in fluids 3636
Motor-functions of brain *3346
Motor, electric, Deprez *3377
Mouffion, the Himalayan *3334
Mountains, green, age of 3633
Mulberry culture in Cyprus 3638
Multiplication simplified 3614
Muscles, cont., microphone in. *3546
Museum, Zoolog., Kensington. *3623
Music in sawmills 3578
Mustard, examination of *3586
Mylitta silk-worm 3668

N

Naphtha in wool scouring 3338
Napier, James R 3414
Narcotic of Australians 3634
National Park, Yellowstone 3668
Nature, art and *3589
Nature, sketching from 3382
Naval combat in Pacific 3368
Navy, Japanese 3694
Nebula, new gaseous 3398
Needles, Cleopatra's *3543
Negatives, intensifying 3694
Negatives, gelatine, intensif'g. 3392
Nervous diseases, climate cure 3694
Neuralgia, remedy, Tonga 3618
Neutralis'g phosphorus in steel 3359
New Orleans, disposal garbage 3633
Newent Collieries, pump'g eng. *3484
New York, railway law in 3679
New York, water-sheds of 3699
N. Y. meteorological observ'y *3319
New Zealand flax in Orkney ... 3510
New Zealand thunderst rm ... 3512
Niaudet's chlo. lime battery .. 3359
Niaudet's chlo. lime pile *3490
Nickel at Paris exhibition 3339
Nickel battery *3541
Nickel and cobalt, separation 3360
Nickel, malleable 3564
Nickel and cobalt 3535
Night-sweats, picrotoxin in ... 3558
Niter 3409
Nitrates, reduction of 3694
Nitric nitrogen in aquaria 3375
Nitrification 3375
Nitrification, researches on ... 3443
Nitrogen, nitric, in aquaria ... 3373
Nitrogen in organic bodies ... 3587
Nitrogen, organisms contain'g 3440
Nordenskjold, Prof *3324
North-east passage *3673, *3688
Northwest, old 3668
Norwegian lighthouses 3417
Novelties in novel location 3708

O

Oak casket, Berlin mus *3696
Obelisks *3543
Obesity, plans to reduce 3619
Obesity, nature and treatment 3345
Observatory, N. Y. Meteorol'l *3319
Oceans, are they disappearing 3630
Octopus and Japanese lady .. 3550
Odor of the soul 3573
Oil, almonds, volatile 3607
Oil, castor, substitute 3601
Oil, cod-liver, substitute 3601
Oil, linseed, protection for iron 3556
Oil, turpent. from pine cones *3442
Oils and wells of Burmah 3547
Oils, lubricating, mineral 3587
Old Northwest 3668
Old Oaken Bucket (version) 3512
Oligiste from lava 3654
Onions, growing 3540
Onions, culture of 3606
Optics *3342
Orange culture, Florida 3621
Orbit of satellite, changes .. 3606
Ordnance, heavy, suggestions 3478
Ore deposits, origin, etc 3654
Organic chemicals 3594
Organisms, microscopic 3461
Orkney, New Zealand, flax in 3510
Oscillating crucible furnace .. *3353
Oscillation of mill buildings .. 3451
Oxygen gas 3594
Oyster eggs, fertilization 3350
Ozone formed in phosphorus .. 3440
Ozone, lines of discovery in .. 3594
Ozone, action on noble metals 3607

P

Pacific coast, man on the 3664
Pacific, naval combat in 3368
Pacific, southern, progress 3615
Paddling canoe, to build *3444
Paint, luminous, Balmain's 3647
Paint, luminous 3630
Painting on glass 3488
Painting on wood 3392
Palace, subterranean 3688
Palander's (Capt.) narrative, *3673, *3688
Palenque tablet, Rau's 3668
Paleontology, Yale College 3679
Paper, ornamental, machines. *3351
Paper, handmade 3615
Paper, expansion of 3693
Paper, gelatin, aniline for 3605
Papin, Denis 3334
Papyrograph 3679
Paris, city of 3398
Paris, exhibition, soda *3410
Paris exhibition, app'd science, 3339, *3387, 3497, 3511
Paris, gas and electricity 3519
Paris, Ste. Chapelle, caps *3661
Park, Yellowstone, national .. 3668
Parkesine or celluloid 3617
Passenger locomotive, fast .. *3675
Passenger engine, Austrian .. *3659
Patentees, interesting to 3414
Pavement, Mosaic *3562
Paving, wood 3438
Pearl, inlaying on iron 3565
Pearl fisheries, Persian 3364
Pellets, cotton, in ear disease. 3460
Persian Gulf pearl fisheries .. 3364
Peru, Cerro de Pasco 3392
Peru, petroleum in 3700
Peruvian s. Huascar, capture .. *3367
Petroleum and benzenes 3667
Petroleum in old world 3634
Petroleum in Peru 3700
Phenol, poisonous properties. 3444
Philadelphia Acad. Nat. Sci... 3381
Phœnicia, archæolog. disc. in. 3446
Phonograph, new 3454
Phosphorescent powder 3604
Phosphorus 3523
Phosphorus oxidation 3444
Photographing colors 3437
Photographing by gaslight 3533
Photographs of microscop. ob. 3404
Photography, mirror in 3580
Photography of the invisible .. 3449
Photo-electro metallurgy 3500
Photo lanterns *3616
Photo-lithographic process 3615
Photo printing 3391
Photo process, new 3487
Phoneidoscope exper., new ... *3490, 3491
Phosphorus in steel 3359
Photo-engraving proc. print'g. 3457
Photographer, Wm. England. *3668
Photographic prints, new proc. 3476
Photography, ornam't glass ... 3564
Photography of microscop. ob. 3379
Photometer, eye as 3693
Phthalic acid 3444
Physics, soda benzoate in 3672
Phylloxera, ravages of 3477
Physical Society, London. 3697, 3682
Physics without app ... *3647, *3687
Piat's crucible furnace *3353
Picrotoxin in night sweats 3558
Pictet's calorific synthesis 3442
Pictet's dissoc. metall. elem .. 3645
Pictures, large, stereoscopes .. 3357
Piercing glass by electric spark *3373
Pile, Niaudet's chlor. lime .. *3490
Pile, thermo-electric *3358
Pilocarpine in baldness 3695
Pine covers, turpentine from .. *3442
Pinions for millstone spindles. 3396
Pitch, number of vibrations ... 3693
Planetarium, new *3655
Plant entrapping moths 3382
Planting trees 3717
Plants, effects of sunlight on. 3510
Plates, rolling *3517
Plates, dry, rapid 3644
Plates, gelatine, development. *3665
Plates, gelatine alkal. develop. 3698
Plates, gelatine 3604
Platino-potassic chloride 3443
Platinum, volatility of .. 3340, 3694
Pleuro-pneumonia 3396
Pneumonia 3493, 3507
Pneumatic foundations *3496
Pneumo-enteritis, infectious .. 3631
Poisons, our domestic ... 3489, 3505
Polariscope, crystals for 3597
Polarity of steel, permanent .. 3679
Polarization of light 3405
Porcelain kilns 3699
Porcelain, manufacture of 3699
Pork, diseased, from America. 3695
Porosity of cast iron 3437
Porosity of building materials *3561
Portland cement 3693
Port wine mark, obliteration .. 3558
Postal stamps 3658
Potash, analysis of 3375
Potassium perman., decomp .. 3683
Potassium chlorate 3410
Potassium chloride 3409
Potassium pyro-chromate 3410
Potassium ferro-cyanide 3410
Potassium cyanide 3410
Potassium iodide 3523
Potassium permang., action .. 3491
Potassium sulphate 3409
Pottery, prehistoric 3546
Poultry in France 3638
Powders, phosphorescent 3604
Powers of eyepieces *3584
Praxinoscope, theater *3570
Precipitates, separ. & treatm't. *3441
Preserving apples 3334, 3348
Pressing, hot, apparatus *3560
Pressure regulator, steam 3416
Printing, autographic proc 3579
Printing, surface, photo. proc. 3457
Printing on woolen 3603
Prints, photographic, new pro. 3456
Prisms *3741
Proa ladronis *3674
Process, new photo 3487
Process, copying 3665
Progress of ship building 3385
Progress of Southern Pacific .. 3615
Proportions of the horse *3586
Ptyalin and diastase 3444
Pulleys, balancing *3516
Pulleys for millstone spindles 3396
Pump, air, simple mercurial .. *3569
Pumps, centrifugal, new uses. 3353
Pumping engines, powerful ... *3369
Pumping engines, Newent col. *3483
Pumping gas into mains *3677
Purification of smoke *3550
Purifier, gas *3719
Purple, London 3476
Pyrene 3650
Pyrethrum powder 3477
Pyramid, ascent of *3652
Pyroheliometer *3471

Q

Questions, milling 3644
Quick watch, to make 3629

R

Radiant energy of sun *3470
Radiograph 3087
Radius, fracture, treatment ... *3666
Railroad law in N. Y 3679
Railroad signals used 3702
Railroad shakes 3478
Railway, Boston Pacific 3560
Railway, bridge, Tay *3399
Railway, Arizona, lands along. 3382
Railway, endless rail *3353
Railway, endless chain mine .. 3550
Railway engine, Austrian *3659
Railway, storm and 3680
Railway or ship canal? 3514
Railway brake, electric *3515
Railway, electric 3681
Railways, tramway, Brown's. *3528
Rail mill, vertical engine for .. *3692
Raisins, California 3701
Range finder, new *3555
Rat exterminator, non-poison .. 3341
Rat king, the *3728
Rau's palenque tablet 3668
Reactions, magnetic *3455
Reaping machine contest 3658
Reclamation of bog land 3526
Recipes for dyeing 3684
Red sea, cross'g by Israelites. 3548
Reflector, speculum for 3411
Refrigerating apparatus *3491
Regenerative gas lighting *3491
Regulators of gas pressure *3405
Regulators, pressure, steam .. *3416
Remedies for skin diseases 3344
Respiration, vegetable 3666
Rheumatism, salicin in 3395
Richardson on thrift 3650
Rider's sprain 3715
Ring spinning 3727
Ring spinning *3387
Ring spinning improvements, *3483, *3497
Rings, colored, on mercury 3440
Rolls, Voith's calendering *3337
Rolling plates *3517
Roman candles *3328
Rose farming 3381
Roses, new class of 3674
Rosin and fats in cements. 3603, 3604
Rotting wood, on 3633
Royal Astronomical Society ... 3398
Royal Academy, design for ... *3501
Rubin, acid 3596
Rudder, telescopic *3329
Ruins, Aztec, Mexico *3606
Rus-ian cruiser 3661
Russian yacht, Livadia 3575

S

Safety valve, when not safety. 3451
Sahara, artesian wells and 3424
Salicin in acute rheumatism .. 3395
Salicylic acid and uses 3600
Salicylic acid, how made 3649
Saligenin, synthesis 3685
Salve for lips 3444
Sandstone, apparatus for 3397
Sanitary appliances 3607
Satellite, changes of orbit 3606
Satellites of Mars 3398
Saturn 3677
Saw mills, music in 3578
Scale insect, to destroy 3702
Scalds, burns and 3573
Scavenging, city, at Boston ... 3610
Science of gas burning 3587
Science at the theatre *3331
Science, applied, Paris exhib. 3497
Science applied to practice 3332
Science, applied, Paris exhib. 3339, 3511, *3387
Science, improv. effected by .. 3355
Science, martyrs of *3334
Sciatica, injection of ether in. 3460
Scouring wool by naphtha 3338
Sea wall *3330
Sea weeds, coloring matter 3629
Seeing by electricity 3681
Serapeum of Memphis 3700
Sesostris, figures of 3349
Severn bridge 3559
Sewerage works, Croydon 3387
Sewerage of cities 3602
Sex in animals, to control 3366
Shape, influence of on attract. 3553
Shellac, sources of 3630
Ship Huascar, capture of *3367
Ship building, progress s 3125
Ship canal or railway? 3514
Ships, dry canal for 3464
Ships, steel vs. iron for 3396
Shock, influence on memory .. 3479
Shoot for timber, Bavarian 3693
Showspeed, Napier's *3417
Sick room, hints for 3500
Signals, railroad, in use 3592
Silk and cotton, mixed 3629
Silver and gold, cupelling 3523
Silver oxide fire 3300
Silver, German, manganese 3345
Silvering glass, process 3564
Silks, black, weighted 3666
Silks and Cashmeres, cleaning 3475
Silkworm, mylitta 3668
Silo, the first 3348
Silica, action of lime in mortar 3340
Silicium, hydride, new 3442
Slate fossils 3368
Slugs, to destroy 3701
Skin grafting 3446
Skin diseases, and remedies ... 3344
Sketching from nature 3382
Smok-prevent'n, boiler furna's 3384
Slow match, to make 3629
Smoke purification *3550
Smoke consumer *3452
Smoke-consum'g furnace, test 3644
Snakes 3708
Soaps and fats, separation 3439
Society, London Chemical 3650
Society, London Physical 3682
Society, Physical, London 3697
Society, Manch'r Lit. & Philos. 3446
Society, Chemical 3440
Society, Royal Astronomical .. 3398
Soda, acetate of, manuf 3719
Soda hypophosphite, prepa'n 3340
Soda sulphite in malarial fever 3459
Soda industry at Paris Exhib. *3410
Soda benzoate in phthisis 3602
Sodium nitrate 3410
Sodium sulphate 3410
Sodium chloride 3410
Sodium polysulphides 3650
Soil-pipe ventilator *3564
Soil for strawberries 3354
Solar light on vegetation 3405
Solar work, spectroscope in .. *3457
Solar eclipses, total 3620
Solar eclipse, 1880 3574
Solids and liquids, expansion. 3592
Solids in gases, solubility 3585
Solids in vacuo, volatilization. 3085
Solubility of solids in gases ... 3361, 3585
Solubility, no'es on 3648
Solvent for gums, new 3502
Sound, wonders of, recent 3454
Space, temperature of 3697
Spain & Algeria, geodesic con. *3635
Spark, electric, spectrum 3469
Spars 3728
Specific gravity of liquids 3699
Specific grav. liquids, to deter. *3443
Spectroscope in solar work ... *3457
Spectroscopic notes 3650
Spectrum of electric spark 3469
Speculum for 37-inch reflector. 3411
Speed indicator, Napier's 3417
Speed of ice yachts *3496
Speed of ice boats *3402
Speedy method in asphyxia ... *3428
Spence's metal 3530
Sperometer, new 3446
Spicen, extirpation of 3573
Spindles, millst's, pulleys, for.. 3396
Spinning, ring, improvements, *3387, *3483, *3497
Spinning, frame, improved *3404
Sportsman of the Landes *3480
Spots on Jupiter *3552
Sprain, rider's 3715
Stage curtains, metal 3369
Standard of light, new 3583
Stamps, postal 3658
Starch and its transformat'ns. 3442
Statist'cs of telegraphs, 1879. 3489
Statue of Galvani *3565
Steam boiler furnaces 3384
Steam boiler, central feed *3416
Steam boilers, gas-fired *3481
Steam commu. with Australia. 3437
Steam engines, revol. cylind'r. *3322
Steam launch, small *3529
Steam plowing apparatus 3707
Steam, permanent polarity 3679
Steam pressure regulators *3416
Steam yacht, stern-wheel *3559
Steamboat wheels 3615
Steamship Arizona *3336
Steamship Galila's pump, eng. *3369
Steamship Macdonnell, eng *3705
Steamship Manhattan *3464
Steamer, catamaran *3574
Steamer Loftus Perkins *3447
Steamers, new stern-wheel *3447
Ste. Chapelle, caps from *3661
Steel, carbon in 3518
Steel, hardening & tempering, 3518, 3529
Steel in the eye, removal 3699
Steel making in China 3693
Steel, nature and composition. 3518
Steel, phosphorus neutraliz't'n 3350
Steel v. iron for ships 3336
Steel, suggestions about 3676
Steel, why does it harden? 3555, 3566
Stereoscopes for large pictures 3357
Stern-wheel steamers, new ... *3447
Stern-wheel steam yacht *3559
St. Gothard Tunnel *3577, *3591, 3607
St. Mary's Church, Brighton .. *3467
Stock, water supply for 3334
Stomach, washing in dyspep .. 3428
Storage, electrical, system 3426
Storm and the railroad 3680
Stoves and chimneys, hot-air. *3382
Stoves, gas 3624
Strawberries, soil for 3334
Subterranean palace 3382
Success 3620
Sues Canal 3675
Sugar, Böttger's test 3696
Sugar cane, animals, injurious 3700
Sugar from corn and sorghum 3414
Sugar juice, purification 3338
Sugar making, Collier on 34 3
Sugar, milk and cane, synthe. 3421
Sugar, test pellets for 3696
Sugars of commerce, value 3536
Sumac leaves, tannin of 3541
Sulphides, metallic, new prop *3375
Sulphur in coal 3698
Sulphur in organic bodies 3587
Sun 3413
Sun, recent eclipse of 3581
Sun, the .. *3370, *3412, *3445, *3457, *3470
Sun, thermometer *3319
Sunlight, effects on plants 3510
Sunshine, recording 3446
Sun's radiant energy *3470
Surgical instrument, novel *3344
Swedish Arctic explor... *3672, 3691
Swedish Arctic exped. .. *3672, 3691
Swedish N. east pass. exped... 3691
Synthesis of saligenin 3685
Synthetic study, geology *3653
Synthesis, Pictet's calorific .. 3442
Synth. of milk and cane sugar 3491
Synthesis, formic acid 3714

T

Tablet, palenque, Rau's 3668
Tannic acid of sumac 3541
Tasar silkworm 3668
Tay bridge *3434
Tay bridge disaster *3421
Tay railway bridge *3399
Tea, effects on system 3346
Tees, breakwater *3405
Telegraph, effect thun. storm. 35.2
Telegraph, Morse, history 3616
Telegraphs, statistics of, 1879, 3489
Telegraph wires in cities 3453
Telegraph, writing *3390
Telemeter, electrical *3647
Telescopes, improvements in. *3504
Telescopic rudder *3329
Temperature of carbon points 3409
Temperature of space 3657
Tempering steel 3518, 3529
Temple, new, at Moscow 3472
Termites *3557
Terry collection pottery 3546
Test for color in wine 3341
Test for gallic acid 3096
Test for sugar, Böttger's 3696
Test-pellets, cupric 3525
Tester, milk centrifugal *3491
Textile display, recent 3439
Textiles, bleaching of 3714
Thames Tunnel, great 3611
Theater, praxinoscope *3570
Theater, science at *3331
Theory of gelat., emuls. proc.. 3682
Thermo-electric pile *3358
Thermometer, pencil *3320
Thermometer, sun *3319
Thirst, effects of 3619
Thoughts on treat't of disease 3443
Thrift in relation to food 3650
Thunderer gun exper'ts. *3431, 3433
Thunderstorm on tel'h line ... 3519
Timber shoot, Bavaria *3396
Tin, analyt. observations 3695
Tin, lead from 3618
Tin, recovery of from scraps .. 3406
Tomato, coloring matter 39 4
Tongs, neuralgia remedy 3618
Tonometer, new 3682
Tools, good, benefits of 3699
Torpedo boat, the Garrett ... *3404
Touchpaper, to make 3479
Tourescope *3479
Toys, manufacture of 3695
Traction engines, military ... *3619
Trade, improv'ts eff'd by sci .. 3353
Tramway, grooveless *3495
Tramway railways, Brown's .. *3528
Transfers, collodion, stripping 3439
Transformation of starch 3442
Transmission, electro-dyn 3466
Transmission of heat 3697
Treatment of horses' legs 3574
Treatment, the vacuum 3443
Tweddell's hydraulic capstan .. *3451
Tree planting 3717
Tree, varnish, Japanese 3730
Trees, forest, of N. America .. 3692, 3657, 3654, 3670, 3686, 3709
Trees, forest, of North Amer .. 3730
Trees, forest, of the U. S 3718
Triangulation, feat in 3577
Trout breeding easy 3541
Tubes, luminous, new 3508, 3586
Tug, dredger and fire engine .. *3395
Tulare Lake, alkaline water .. 3712
Tunnel, Hudson River *3610
Tunnel, St. Gothard *3577, *3591, 3607
Tunnel, Thames 3611
Tunnel under Mersey 3401
Tunnels and arches, beton *3607
Turkeys, raising of 3621
Turkish bath, the 3390
Turner, James L 3704
Turner's gas engine *3466
Turpentine, Chian 3721
Turpentine oil from pine cones *3442

U.

Ultramarine 3604
Ultramarine compounds 3443
Underground London *3389
United States, compass varia .. 3627
United States, dentistry in 3699
United States, forest trees of. 3718
United States, lakes, distrib .. 3691
Urari, how made 3601

V.

Vaccination, delusion 3692
Vacuum treatment, the 3443
Vaginal douche, hot water 3429
Valve, safety, when not safety. 3451
Van Cotta, Bernhard *3632
Vanillin 3444
Vapor, aqueous, action carbon 3574
Varnish, improved 3405
Varnish tree, Japanese 3730
Varnishes for iron 3603
Vegetable for china, new 3510
Vegetable respiration 3678
Vegetation, action acid vapors 3461
Vegetation, action solar light. 3405
Vegetation, electric light 3444
Vegetation injured by gases ... 3604
Ventilator, soil pipe *3564
Vessels, fast speed 3417
Vesuvius, oligiste from 3604
Vibration of mill buildings 3451
Vibrations, num. recog. pitch. 3469
Violet coloring matter, new ... 3474
Violets, methyl aniline 3697
Virginia coal and iron mines .. 3627
Viscous materials, flow of 3584
Voith's calendering rolls *3337
Volatility of platinum 3394
Volcanic eruptions 3704
Volcanic erupt'n in Dominica. 3548
Voltaic arc experiment *3616

W

Walls, sea *3336
Water and air, on 3508
Water, alkaline, Tulare Lake .. 3712
Water, boiling, annealing in .. 3706
Water cistern, position 3497
Water, detecting org. matter in 3603
Water filters, utility of 3393
Water, ice, in diarrhœa 3619
Water in milk, test apparatus. *3690
Water, mineral, apparatus 3393
Water of squaria, nitrogen in.. 3375
Water, proportion in alcohol .. 3604
Water-sheds of New York 3699
Water supply for stock 3344
Washington Monument, foun .. 3609
Wealth, health is 2682
Wealth, mines as sources 3613
Weighing apparatus, Craig's .. *3327
Weighted black silks 3666
Weights, precaut'ns in comp'g 3584
Weirs, fixed and movable 3496
Weirs and dams in India 3506
Wells, artesian, and Sahara ... 3424
Wells, oil, of Burmah 3547
Werdermann elec. lamp, new .. *3453
Western mining regions 3499
Whale, Charleston *3717
Wheat fields, Athabasca 3701
Wheat handling, America 3663
Wheat, how it grows 3701
Wheat, how it should be prep .. *3726
Wheels, steamboat 3615
Windlass, hydraulic *3451
Window gardening 3664
Wine coloring, test for 3341
Wires, molecular change 3655
Wires, telegraph, in cities 3453
Women, hygiene in education. 3477
Wonders of light, recent 3582
Wonders of sound, recent 3454
Wool and cotton, mixed 3629
Wool cleaning machine *3422
Wool, colors for printing on ... 3684
Wool, electricity in 3616
Wool scouring by naphtha 3338
Woolen cloth, soaking of 3606
Woolen, printing on 3684
World, Old, petroleum in 3634
Wounds, antiseptic dressing .. 3444
Writing ink, non-corrosive 3328
Writing telegraph *3390

X

Xylonite, or celluloid 3617

Y

Yacht Livadia, Russian 3374
Yacht, ice, speed *3496
Yacht, steam stern-wheel *3559
Yale College and paleontology. 3679
Yarn, jute, bleaching 3514
Yarn, woolen, condenser for .. *3708
Yellow fever 2509
Yellowstone National Park 3668

Z

Zander's mechanical gymnast. *3397
Zinc as boiler protector 3554
Zinc in separation of gold 3650
Zinc powder, value 3667
Zoological Mus., Kensington .. *3623